The American Journal of Surgery

Copyright, 1953 by The American Journal of Surgery

A PRACTICAL JOURNAL BUILT ON MERIT

Sixty-second Year of Publication

VOL. LXXXVI DECEMBER, 1953 NUMBER SIX

Editorial

SURGERY IN THE AGED

GERONTOLOGY or geriatrics is the science of the physiologic and pathologic changes incident to old age. It is difficult to set a line at which middle age ends and old age begins since most people believe that "a man is as old as he feels" or "a man is as old as his arteries." I have arbitrarily placed those past sixty in the old age group knowing full well that it is the physiologic rather than the chronologic age that matters.

The average span of life has definitely increased. From a forty-nine year expectancy at the turn of the century, the expectancy is now sixty-eight years. The surgeon is now confronted with an ever increasing number of old age patients who will not accept dismissal as "too old for surgery."

Two types of old people were long ago described by Sir James Paget. "Years, indeed, taken alone are a very fallacious mode of reckoning age. It is not the time but the quantity of man's past life we have to reckon . . . . The old people that are thin and dry and tough, clear voiced and bright eyed, with good stomachs and strong wills, muscular and active are not bad; they bear all but the largest operations very well. But very bad are they who looking somewhat like these, are feeble and soft skinned with little pulses, bad appetites and weak digestive power; so that they cannot, in an emergency, be well nourished." Also, "the heart or excretory apparatus that has successfully withstood the insults of 70 years of active duty is often likely to come through a major surgical procedure with flying colors."

Recent statistics have given ample evidence that in spite of the increased risk of operation in the aged, well planned surgery with proper preoperative care, good choice of anesthesia given by a well trained anesthetist and meticulous postoperative care will carry the aged patient through major surgical procedures that formerly failed. Until recently surgery in the aged was performed only in an extreme emergency and elective procedures were avoided because of the surgeon's reluctance to accept the danger of an assumed or a real mortality.

In 1936 Brooks reported 300 operations upon patients over seventy years of age, with a mortality of only 5 per cent. Carp in 1946 reported 450 major procedures in patients over sixty years, in a municipal hospital where the general and nutritional condition of the patients was much worse than might be expected in private hospitals. The mortality ranged between 25 and 30 per cent. The number of older persons occupying hospital beds has increased considerably. The operation indicated has become more extensive since it deals with severe infections, severe fractures, carcinoma, peripheral vascular disease and other surgery of the aged. The risk of operation has become greater. However, our improved methods of combating operative risk have given us the courage to proceed with the necessary surgery.

What are the physiologic and pathologic

risks which occur with aging that require the surgeon to take more detailed and extra care to make the aged patient safe for surgery? These are listed as follows, although not in their order of frequency, with the counteracting procedures in general for each:

Risks Due to Anesthesia. The experience of most clinics with the preoperative use of small doses of morphine and scopolamine is satisfactory. Regional anesthesia with procaine and without adrenalin possesses the widest margin of safety. The combination of cyclopropane and oxygen enjoys widespread use because of the high concentration of oxygen and the low irritability. It also has the advantage of rapid recovery rather than a prolonged period of unconsciousness after cessation of administration.

Ether is irritating to the respiratory tract and may predispose to pulmonary complications, vomiting, acidosis and hepatic dysfunction. However, it is the anesthetic of choice in the cardiac case.

The anoxia that may accompany nitrous oxide and oxygen is dangerous. However, this combination has its usefulness in the short case.

Ethylene has been discontinued in most hospitals because of the explosive risk.

In cases in which a fall in blood pressure is dangerous, spinal anesthesia is to be avoided. Caudal or epidural anesthesia may occasionally be the anesthetist's choice.

Pentothal® is enjoying more widespread use for induction purposes.

Refrigeration anesthesia may be desirable in lower extremity amputation.

Hemorrhage and Shock. These are undoubtedly the result of several unfavorable factors. Chief among these is blood loss during operation and that lost into tissues postoperatively. Gentle handling of tissues, effective hemostasis and replacement of blood loss with truly compatible blood are of importance.

Postoperative Pulmonary Lesions. In this group are atelectasis, massive collapse and pneumonias. In most patients the pulmonary complications are the result of interference with respiratory movements and an inability to evacuate bronchial secretions during and after operation. Effectiveness of aspiration during and after operation is stressed. There is occasional need for bronchoscopic aspiration of an inspissated bronchial mucous plug or of aspirated food particles. The stomach should be empty before operation.

Phlebothrombosis, Thrombophlebitis, Pulmonary Infarct, Fatal Embolus. Early ambulation is advantageous except in shock, heart failure, severe anemia, hemorrhage, presence of thrombi or emboli, or in conditions such as peritonitis and pancreatitis. Anticoagulant therapy where indicated is encouraging, and the same may be said for femoral or even iliac vein ligation.

Wound Infection, Dehiscence and Evisceration. Free use of antibiotics and gentle handling of tissues are stressed. Lightweight suture material should be used and an excessive number of sutures should be avoided to prevent strangulation of tissues.

Imbalance of Biochemical Processes. In this group the following may be listed: anemia dehydration, electrolyte imbalance, hypoproteinemia, vitamin deficiency; aged patients are especially prone because of an underlying surgical problem such as malignant disease, pyloric obstruction, intestinal obstruction and jaundice. Such chemistry studies as non-protein nitrogen, CO_2, chlorides and sugar must be done. Known deficiencies should be replaced and decompression by intubation should be done for distention and obstruction. Intestinal antibiotics are necessary and vitamin K needs in jaundice should be filled.

Fat Embolism. Gentle handling of tissues and avoidance of closure of compound fractures are requisites.

Diabetes Mellitus. The seriousness of this complication can be almost entirely eliminated by expert supervision. The diabetic with elective surgery should be stabilized before operation; the emergency diabetic should be controlled to the point of falling blood sugar (as determined at hourly intervals) before surgery.

Diminished Cardiac Reserve. Cardiac irregularities or ventricular fibrillation may follow too great concentrations of anesthesia. Cardiac standstill may result from vagal stimulation. Avoid prolonged asphyxia by adequate oxygen, free airways and controlled respiration until all danger is past. Overdigitalization may induce vomiting and its accompanying train of symptoms. Electrocardiographic studies should be done.

Impaired Renal Function. Urine and chemistry studies are essential. A minimum urinary output of 1,000 cc. daily is desired.

In conclusion, gratifying advances have been made during the past few decades in the surgery

of the aged. This is due in large part to better familiarity with their medical problems, their pathologic physiology and our increased ability to restore and maintain their functions as nearly normal as possible during the pre- and postoperative periods. Diligent cooperation between the physician, the surgeon and the laboratory will continue the reduction of surgical mortality in the aged.

SIDNEY HIRSCH, M.D.
Diplomate, American Board of Surgery
Cedarhurst, L. I.

LOUIS E. PHANEUF, M.D.
1884–1953

LOUIS E. PHANEUF, Professor of Gynecology at Tufts College, after a long and eminently successful career devoted to the specialty of obstetrics and gynecology, died last September. Our friendship began at a breakfast during a convention in Niagara Falls over twenty-five years ago. For over two decades Dr. Phaneuf served on the Editorial Board of this Journal. He was an indefatigable worker. He labored long hours. We made unusual demands upon him, yet he never refused or put off doing an accepted task. We last saw him at a sectional meeting of the American College of Surgeons in Quebec, where he presented a paper in French. He showed little evidence of his years; he was robust and gave the impression of stored energy. He was a teacher, a skillful surgeon and the author of many articles of outstanding merit. We, personally, and The Journal have lost a friend and a valuable contributor. We mourn his passing and ever will cherish his memory.

T. S. W.

Original Articles

TOTAL GASTRECTOMY

M. Tischer Hoerner, M.D., PH.D.
Dayton, Ohio

ONLY a few years ago total gastrectomy was performed successfully upon relatively few patients. The high mortality of the operation and the lack of knowledge concerning the physiologic changes resulting from removal of the entire stomach limited the use of the procedure and the exploration of its possibilities. Total gastrectomy is now an accepted surgical procedure. The technical difficulties encountered in the performance of the operation have been worked out and basic principles established. These technical developments, together with the advent of chemo-antibiotic therapy and advances in anesthesia and in the pre- and postoperative care of patients, have resulted in progressive improvement in the mortality of this radical surgical procedure. Studies carried out upon individuals who have survived the early operations have established the fact that patients who have had the entire stomach removed can maintain their weight and strength if the proper type of diet and supplemental medication are administered.

If total gastrectomy can be performed with a reasonable degree of success in the treatment of carcinoma of the stomach and if the patients can be maintained in health after recovery from the operation, it would seem that the indications for the procedure can be greatly extended. This is undoubtedly true. Furthermore, the studies of Coller, Kay and MacIntyre[1] on the regional lymphatic metastasis of carcinoma of the stomach support the more frequent use of total gastrectomy. These men found metastasis to regional lymph nodes in 75 per cent of the patients studied. They reported that the upper margin of the tumor could not be determined by palpation at the time of operation in 24 per cent of the patients. Abrahamson and Hinton[2] found that only 28 per cent of 444 cases of gastric carcinoma were unfavorably located for a total resection. Longmire[3] is of the opinion that just as radical mastectomy is preferred in the treatment of malignant tumors of the breast, total gastrectomy is the procedure of choice in the treatment of many gastric malignancies instead of routine subtotal resection. Six cases in which total gastric resection was performed for carcinoma of the stomach are reported in this paper.

While the field for the employment of total gastrectomy has been definitely broadened, it is necessary to point out that overenthusiasm should be tempered by caution and good surgical judgment because total gastrectomy will probably always be somewhat more hazardous to perform than subtotal gastric resection. Furthermore, while the weight and strength of patients who have had the entire stomach removed can be maintained with the assistance of special measures, the general state of health of these individuals is not as robust as those who have been permitted to retain a portion of normal stomach tissue.

On being confronted with these facts it is essential to determine when total gastrectomy should and should not be performed. In general, total gastrectomy is indicated when the disease of the stomach, endangering the life of a patient, is confined to the stomach and so much of the organ is involved that nothing short of its total removal will eliminate the disease. Linitis plastica is an excellent example of such a condition. The tissue spaces, muscular distribution, lymphatic pathways and vascular channels of the stomach all assist in the permeation of carcinoma through the organ. The leather bottle type of stomach resulting from carcinomatous infiltration of all or the greater part of stomach may be treated by total gastrectomy because of the frequency with which the disease is confined to the stomach itself. Three of the patients in this series suffered from lesions of

this character. If subtotal gastrectomy is attempted when carcinoma of this type involves the greater part of the stomach, several biopsies should be taken from the severed end of the stomach which is to be anastomosed to the jejunum in order to assist in eliminating the hazard of leaving carcinoma beyond the grossly evident borders of the growth.

While total gastrectomy offers the best chance of a cure when extensive carcinoma is confined to the stomach without evident lymph node metastasis, the field of its application has been widened even further in recent years. It is the only operation that offers an opportunity to save patients when carcinoma of the pylorus has extended to the cardiac lymph nodes. Three patients in this series had malignant tumors of this type. Farris, Ranson and Coller,[4] and Jones and Kehm[5] suggest that the operability rate of carcinoma of the stomach would be increased and the percentage of five-year cures improved if total gastrectomy were performed more frequently, even in the treatment of earlier malignant lesions of the stomach. Fluoroscopic examination usually offers more information as to the degree of involvement of the stomach by a malignant lesion than roentgenograms. In some instances esophagoscopy may yield added data regarding the extent of the gastric tumor. The operability of cancer of the stomach cannot always be determined with certainty before operation. There is no relationship between the duration of symptoms, size of the tumor and lymphatic metastasis. The feasibility of performing subtotal or total gastrectomy can be decided at the time of operation when the location and extent of the neoplasm are known. Distant metastases found before operation or at the time of laparotomy preclude the performance of radical gastric surgery.

PREOPERATIVE CARE

It is believed that thorough preparation of the patient for extensive gastric surgery is essential and will materially affect the mortality rate of the operative procedure. Several days' hospitalization is necessary for this purpose. During this time the general physical state of these individuals can be studied and efforts directed toward improving correctable defects. The diet should contain high protein and carbohydrate values. If partial obstruction of the pylorus is present, these substances should be incorporated in a liquid type of diet which the patients are able to assimilate. The diet can be supplemented with daily intravenous injections of glucose to improve the glycogen reserve in the liver. Secondary anemia and hypoproteinemia can be corrected by repeated small blood transfusions. When pyloric obstruction exists, daily gastric aspirations tend to decrease gastric edema and improve the circulation in the wall of the stomach. As many gastric carcinomas are accompanied by a degree of secondary infection, repeated gastric lavages with tenth normal hydrochloric acid tend to reduce the number of the pathogenic bacteria present.

OPERATIVE TECHNIC

Many types of incisions have been employed in performing total gastrectomy. All of them have advantages and disadvantages. In two instances in this series in which the costal arches flared widely, very good exposure was obtained by transverse incisions extending across the upper abdomen from the lower costal margin on one side to that on the other. However, in most instances the best exposure was obtained by a high upper left rectus incision. An incision in the upper midline was avoided because such wounds often do not heal as readily as those already mentioned.

After thorough exploration has revealed that the stomach is resectable and distant metastases are not present, the greater omentum is freed from the transverse colon. The right gastric artery, gastroduodenal artery and the right gastroepiploic vessels are ligated and cut. The duodenum is severed close to the head of the pancreas and closed by an over and over basting stitch. This closure is reinforced by another row of continuous chromic catgut suture material, as well as by an outer interrupted row of silk sutures, which includes the peritoneum reflected off the duodenum below the point where the duodenum was severed and the peripancreatic capsule. The greater curvature of the stomach is then mobilized and all vessels leading to it ligated. At times it may be necessary to remove the spleen when doing a total gastrectomy. Troublesome bleeding may result from injury to the vessels at the hilus of the spleen which lie immediately beneath the greater curvature of the stomach. If the vasa brevia are difficult to visualize, they may be traumatized during dissection and cause bleed-

ing which is difficult to control. When the splenic lymph nodes are involved secondary to the carcinoma of the stomach, the spleen must of necessity be removed. Splenectomy had to be performed in two of the six cases reported. Ordinarily, splenectomy adds little to the operation and the organ should be removed without hesitation if there is a clear-cut indication.

If the stomach is elevated to the left, after mobilizing the greater curvature, the left gastric vessels are clearly visible. These are ligated close to their origins and the remaining small vessels of the lesser curvature controlled. The lymph nodes at the celiac axis can then be removed.

Additional exposure of the abdominal esophagus can be obtained by cutting the triangular ligament of the left lobe of the liver and gently retracting this portion of the liver to the right. It is well to leave the stomach attached to the esophagus for traction purposes, at least until the two posterior rows of the anastomosis have been placed. At this time anterior and posterior flaps of peritoneum, which is reflected off the diaphragm onto the esophagus, can be raised. These flaps begin at the gastrohepatic omentum on the right and extend across the esophagogastric juncture to the left side of the diaphragm. Cellular tissue attached to the esophagus now can be gently wiped upward for a distance of about 2 inches. This procedure cannot be performed too vigorously, for the esophagus is a relatively delicate structure and care must be taken that the blood supply to the lower end of the esophagus is not injured.

Severance of the vagus nerves on each side of the esophagus was found to be of considerable advantage in one case of this series in which the abdominal portion of the esophagus was extremely short. The additional few centimeters of esophagus obtained by this maneuver were of great assistance in performing the gastrojejunal anastomosis.

Both retrocolic and antecolic anastomoses have been used in this series but at the present the antecolic anastomosis is employed unless the jejunal mesentery is shorter than normal. However, when the retrocolic type of anastomosis has been used, the transverse mesocolon has been sutured across the jejunal loops obliquely as recommended by Morton.[6]

The esophagojejunal anastomosis employed in this series consisted of an outer row of interrupted silk sutures and an inner row of a continuous chromic catgut suture. The inner continuous suture was locked when inserted in the posterior portion of the anastomosis to assist in preventing constriction of the stoma. When the anastomosis was completed, a Levin nasal tube was passed through the anastomosis into the descending limb of jejunum in two patients in this series. This was employed in order to put the anastomosis at complete rest and to permit early feeding of the patient through the indwelling tube. Although this procedure may be indicated when immediate feeding of the patient is required, it is not essential to the healing of the anastomosis.

After completion of the anastomosis the posterior and anterior flaps of peritoneum reflected off the diaphragm are laid over the anastomosis and sutured to the jejunum. By so doing, the anastomosis is not only covered and reinforced, but also the weight of the long loop of jejunum and its mesentery is prevented from putting undue strain on the suture line of the anastomosis. Suturing the jejunum to the underneath side of the diaphragm on either side of the anastomosis further aids in relieving the stress of the anastomosis.

Jejunostomy was performed only once in this series and jejunojejunostomy twice. Leakage from the duodenal stump is one of the complications that must always be kept in mind when performing gastric resection. Although passage of the bile and pancreatic juice through an enteroanastomosis between the two limbs of jejunum may tend to relieve pressure on the duodenal stump and minimize this complication, it is believed that present methods of more careful closure of the duodenal stump and establishment of an adequate stoma at the esophagojejunal anastomosis eliminate the necessity for this additional procedure in the great majority of instances.

Before closing the abdominal wound it is well to place a Penrose drain in the region of the esophagojejunal anastomosis and another similar drain near the duodenal stump. These drains can be brought out through a stab wound to the right of the main incision. If leakage does occur from either of these sites, the drains will assist in establishing a tract to the outside of the abdomen and generalized peritonitis may be prevented. The drains are shortened on the third and fifth postoperative days and removed the seventh day after operation. Five grams of sulfathiazole powder

sprinkled about the anastomosis and the duodenal stump decrease the danger of contamination in these areas.

The abdominal wounds are closed in layers. The peritoneum is brought together with a continuous chromic catgut suture. In both the transverse and the left upper rectus incisions the fascial layers are approximated with interrupted cotton sutures and the skin with interrupted silk sutures. All wounds in this series healed by first intention.

POSTOPERATIVE TREATMENT

One or two blood transfusions of 500 cc. each were given during the course of the operation to prevent shock. As there is almost invariably a drop in blood pressure when the patients are transported from surgery to their hospital rooms, one of these transfusions was always continued during this critical period. The essential fluids administered to the patients by hypodermoclysis and intravenous injection were supplemented by blood during the first twenty-four hours until the blood pressure and pulse were stabilized. The use of the Trendelenburg position the first few hours after the operation was of value in preventing shock and aided the patients in raising accumulated bronchial and tracheal secretions. Nasal oxygen was employed in all of these patients during the first twenty-four hours. After the patients had fully reacted from their anesthetic, they were encouraged to take deep-breathing exercises frequently and to blow up a paper bag hourly. Until the patients could change their positions themselves they were turned every two hours and reminded to move their feet and legs much of the time while they were awake. Unless there was some definite contraindication, the patients were helped out of bed and walked the first or second day after operation.

Feedings through the nasal tube which passes into the intestine beyond the anastomosis were begun the morning after the operation. At the start these feedings consisted of 2 ounces of albumin water every two hours. If this was well tolerated, the feedings were gradually increased in amount and caloric content. A similar procedure was carried out in the one instance in which a jejunostomy tube had been employed for feeding purposes. Supplementary fluids consisting of 5 per cent glucose or normal saline or protein hydrolysates were administered intravenously daily. Therapeutic doses of both Vitamin B and C were added to at least one of these intravenous injections daily. Small blood transfusions of 250 cc. each were given every two or three days depending on the hemoglobin determinations, red blood cell count and total blood protein values. In each instance in which the nasal tube was used for feeding purposes it was removed on the fifth postoperative day because the constant irritation of the tube resulted in the accumulation of an excessive amount of secretion in the nasopharynx.

In three instances a tube was not used for feeding purposes. These patients were given nothing by mouth until the fourth postoperative day although the mouth was kept clean and moist by frequent cleansings and mouth washes. On the fourth day ½ ounce of water was given every hour. This was increased to 1 ounce every hour the fifth day and 2 ounces every hour the following day. Supplemental intravenous fluids as outlined heretofore were continued during this time. By the seventh postoperative day substitutions such as albumin water, milk with one teaspoonful of lime water added, jello and gruel began to be made for the gradually increasing amounts of water tolerated by mouth. Cream of wheat and soft-cooked eggs were added the ninth postoperative day. Fourteen days after operation the patients were usually able to assimilate six small soft feedings daily. As soon as the patients were able to tolerate soft foods, liver, iron and multiple vitamins were added as supplements to the diet. The patients were kept on small frequent feedings of bland foods for several weeks and instructed to take ten drops of dilute hydrochloric acid with each meal.

MORTALITY

Reports in the literature indicate that the operative mortality for total gastrectomy is declining. In 1927 Finney and Rienhoff[7] stated that the mortality rate for this procedure was approximately 50 per cent. Vidgoff[8] verified this observation. West[9] performed total gastrectomy in eighteen cases, with an operative mortality of 39 per cent. Lahey[10,12] had a 55 per cent mortality rate in 1939, as compared to 16.3 per cent in 1947 reported by Smith[11] and 10.3 per cent in 1950. Walters, Gray, and Priestley,[13] had only fifteen deaths in 103 total gastrectomies by 1942. Pack, McNeer and

Booker[14] had a mortality of 31.7 per cent in forty-one operations. The immediate causes of death in the series reported by Pack et al. were as follows: pneumonia, 46.1 per cent; peritonitis and abscess formation, 23.1 per cent; cardiac failure, 23 per cent; and postoperative anuria, 7.8 per cent. Of the six cases reported in this series there was one death. This patient died of peritonitis. The other five patients made uneventful recoveries.

PHYSIOLOGIC EFFECTS OF TOTAL GASTRECTOMY

Our knowledge concerning the physiologic effects of the removal of the entire stomach has been improved by studies conducted upon an increasing number of individuals who have had prolonged survival periods. The result of the loss of an efficient container and mixer of ingested food is immediately apparent. However, patients have the ability to adjust themselves to this abnormal situation by eating smaller meals more frequently. Such individuals gradually take more food at a time until they are able to maintain their state of nutrition on the amount ingested three times a day.

It is essential to determine whether other indispensable functions of the stomach have been lost by total gastrectomy. The peptic activity of the stomach is of little importance as the duodenal and pancreatic secretions contain sufficient protolytic enzymes. Smithwick[15] found evidence of disturbed fat metabolism in three patients and changes in protein metabolism in one patient from three to fourteen months after operation. Four other patients showed no abnormality of either protein or fat metabolism. Farris, Ranson and Coller[4] found no disturbance of digestion of fats or proteins in four patients who lived four years. However, they found that glucose was absorbed more rapidly than normal. This observation was verified by Smithwick.[15]

The loss of hydrochloric acid, while not unimportant, often causes relatively few symptoms particularly late in life. However, in the absence of hydrochloric acid in the stomach, ferric and organic iron in the food is not fully utilized. Under these circumstances hypochromic microcytic anemia often develops unless the patient is given ferrous iron regularly. Instances have been reported in which pernicious anemia has developed following total gastrectomy. Pernicious anemia develops when the antipernicious anemia factor is absent. This substance is produced in the gastrointestinal tract by the interaction of the extrinsic factor, contained in the food, and the intrinsic factor, an enzyme produced in the pyloric end of the stomach and duodenum. Interference with either factor results in pernicious anemia. Meulengracht[16] determined that the glands of the cardia and pylorus and Brunner's glands in the duodenum are functionally identical. The presence of Brunner's glands in man accounts for the fact that every patient with gastric atrophy or gastric resection does not develop pernicious anemia. Jones[17] points out that in animal experiments anemia following gastric resection develops only after many months or years. He is of the opinion that total gastric resection can be performed without fear of undue changes in the hematopoietic system of the patient. An occasional microcytic or macrocytic anemia may develop months after the operation. Postoperative dietary management together with the administration of small doses of liver and iron prevent these complications.

Two patients who survived total gastrectomy in this series were not given either liver or iron postoperatively. Both of them showed evidence of hypochromic microcytic anemia eight and twelve months, respectively, after leaving the hospital. Ferrous sulfate was administered daily until this condition was corrected. A maintenance dose was then given. The remaining three patients were started on liver, iron and dilute hydrochloric acid before leaving the hospital. This regimen controlled the tendency toward anemia quite well. Macrocytic anemia did not develop in any of these patients. No evidence was discovered in these patients of disturbance of either fat or protein metabolism. Glucose tolerance tests were made on three patients. Each test revealed marked initial hyperglycemia followed by a rapid fall in these high levels, suggesting more rapid absorption of glucose.

SURVIVAL

Of the five patients in this series who survived the performance of total gastrectomy one patient died ten months after operation and another died two years following the procedure. It was doubted at the time of operation that either of these patients would obtain a cure, for they both had extensive carcinomas involving the pyloric half of the stomach with metastasis

to the cardiac lymph nodes. Both patients died from recurrence of the carcinoma. Nevertheless, they both were free from distressing gastric symptoms for six months and one and a half years, respectively. During this time they were active and carried on a great many of their normal activities. Even though the operations were not successful in establishing a cure, the prolongation of life and the freedom from distress that these patients had during much of this time justified the performance of the procedure.

A third patient lived four years after total gastrectomy. Although he had extensive carcinoma of the stomach, the lesion was of the linitus plastica type. This patient maintained his weight and returned to work until three and a half years after the operation when evidence of recurrence developed. A fourth patient, seventy-four years of age, is living and well three years, four months after total gastrectomy for a linitus plastica type of carcinoma of the stomach. He is able to maintain his weight on three meals a day. Although much of his food is heavily seasoned, he has no digestive symptoms. While this man is retired, he leads an active social life.

A fifth patient, sixty-six years of age, has survived for eighteen months after total gastrectomy for adenocarcinoma of the pylorus with lymph node metastases. She was so weak from inability to eat that she was confined to bed for three weeks prior to admission to the hospital. At present she is eating well and has regained her weight and strength. Since assuming her household responsibilities the mental improvement in this patient has been remarkable.

SUMMARY

There has been progressive improvement in the operative mortality of total gastric resection in recent years. Although at least 50 per cent of the patients submitted to this procedure died prior to 1926, more recent reports indicate uniformly better results in the hands of many men. This has been accomplished by solving many of the technical difficulties encountered in performing the operation, by the advent of chemo-antibiotic therapy and by improvements in the pre- and postoperative care of patients.

Studies of an increasing number of patients who have survived for prolonged periods after the operation have established the fact that individuals who have had their entire stomach removed are not condemned to invalidism. The physiologic changes in the gastrointestinal tract, as well as general systemic changes, resulting from total gastrectomy can be controlled in most instances by administering the proper type of diet together with supplemental medication. As a result, these patients can be maintained in good health and can return to many of their former activities. Because of the improvement in the operative mortality of total gastrectomy and the ability to maintain the weight and strength of individuals who have survived the procedure, the operation should no longer be considered suitable for removing extensive malignancies of the stomach for palliative purposes alone. It is the only procedure that offers a chance to increase the percentage of five-year cures when carcinoma of the pylorus has extended to the cardiac lymph nodes. Because of the reasons mentioned before and the fact that it is often impossible to tell by palpation whether or not lymph nodes have been involved by carcinoma of the stomach, it has recently been suggested that subtotal gastric resection should be subplanted by total gastrectomy in all instances of gastric malignancy. Whether or not such a radical viewpoint is justified will have to be determined by the results of comparative studies after total gastrectomy has been employed in more instances.

REFERENCES

1. Coller, F. A., Kay, E. B. and McIntyre, R. S. Regional lymphatic metastasis of carcinoma of stomach. *Arch. Surg.*, 43: 748–761, 1941.
2. Abrahamson, T. H. and Hinton, J. W. Carcinoma of stomach. *Surg., Gynec. & Obst.*, 71: 135–141, 1940.
3. Longmire, W. P., Jr. Total gastrectomy for carcinoma of stomach. *Surg., Gynec. & Obst.*, 84: 21–30, 1947.
4. Farris, J. M., Ranson, H. K. and Coller, F. A. Total gastrectomy; effects upon nutrition and hematopoiesis. *Surgery*, 13: 823–833, 1943.
5. Jones, T. E. and Kehm, R. W. Total gastrectomy. *Surg., Gynec. & Obst.*, 80: 534–538, 1945.
6. Morton, C. B. Total gastrectomy. *Arch. Surg.*, 44: 72–80, 1942.
7. Finney, J. M. T. and Rienhoff, W. F., Jr. Gastrectomy: five cases. *Tr. South. S. A.*, 40: 424–435, 1927.
8. Vidgoff, I. J. Transthoracic total gastrectomy for carcinoma of the stomach. *Am. J. Surg.*, 77: 68–71, 1949.
9. West, J. P. Total gastrectomy. *Ann. Surg.*, 129: 373–380, 1949.

10. Lahey, F. H. Experiences with gastrectomy, total and subtotal. *New England J. Med.*, 220: 315–321, 1939.
11. Smith, F. H. Total gastrectomy. *Surg., Gynec. & Obst.*, 84: 402–408, 1947.
12. Lahey, F. H. Total gastrectomy for all patients with operable cancer of the stomach. *Surg., Gynec. & Obst.*, 90: 246–248, 1950.
13. Walters, W., Gray, H. K. and Priestley, J. T. Carcinoma and Other Malignant Lesions of the Stomach. Philadelphia, 1942. W. B. Saunders Co.
14. Pack, G. T., McNeer, G. and Booker, R. V. Principles governing total gastrectomy. *Arch. Surg.*, 55: 457–485, 1947.
15. Smithwick, R. H. Total gastrectomy with particular reference to closed (aseptic) esophojejunostomy. *New England J. Med.*, 220: 315–321, 1939.
16. Meulengracht, E. Continued investigation on presence of the anti-anemic factor. v. Preparations from the duodenum. *Acta med. Scandinav.*, 85: 79, 1935.
17. Jones, C. M. The problems of gastrectomy and the anemias. *Am. J. Digest. Dis.*, 7: 502–505, 1940.

Recent statistics on several large series of consecutive cases of cancer of the female breast show that only 20 per cent of these patients survive five years if untreated, whereas double this number live at least five years if treated; this rate would probably increase to 60 per cent if patients were treated within one month of symptoms. When cancer is limited to the breast (stage I), this survival rate jumps to 75 per cent. If axillary metastases are present (stage II), the survival rate is about 40 per cent. If the cancer of the breast is advanced (stage III), this rate drops to less than 20 per cent. Patients with distant metastases (stage IV) are more rarely encountered; not a single one of these patients is apt to survive five years. (*Richard A. Leonardo, M.D.*)

SOME ELASTIC CHARACTERISTICS OF FRESH AND FREEZE-DRIED AORTIC GRAFTS*

LIEUT. JAMES W. PATE, M.C. AND LIEUT. PHILIP N. SAWYER, M.C.
Birmingham, Alabama *Philadelphia, Pennsylvania*

IT was the belief of a life-long student of arterial disease that "From the point of view of clinical medicine the physical characteristics of the aorta are much more significant than are the histologic details."[1] These studies were designed to bring both elasticity criteria and microscopic observations to bear upon the problem of evaluating arterial grafts. Beyond this correlation, a study of the elastic properties of implanted aortic grafts should be of value as an aid in predicting the probability of a rupture or aneurysm formation. Studies with heterografts have shown a direct correlation between the loss of elastic fibers and the development of aneurysms.[2] For other aspects of the over-all work, including more detailed histologic studies, other papers from this laboratory may be consulted.[2-8]

METHODS

This study is concerned with a comparison of the elastic characteristics of aortic segments before and after implantation into the abdominal aortas of dogs. Details of the implantation studies are reported elsewhere.[2-8]

The artery to be studied was removed from anesthetized animals and transferred directly into 0.85 per cent NaCl solution. Longitudinal strips, 0.3 to 0.5 mm. wide and 2.5 mm. long, were placed in the apparatus shown diagrammatically in Figure 1. The essential features of the apparatus include a continuous weight-loading device and a recording system to register the change in length. Careful attention was given to the following: (1) The apparatus was balanced to avoid initial tension on the vessel. (2) Strong, smooth clamps were well fixed to avoid slipping. (3) The specimen was kept moist with physiologic saline. (4) A slow rate of stretch was used, at which the absence of significant hysteresis was demonstrated. The absence of slipping was shown by obtaining repeated identical curves from the same specimen. Unloading at the same rate was done on fifteen aortic segments. There was no significant difference between loading and unloading under these conditions.

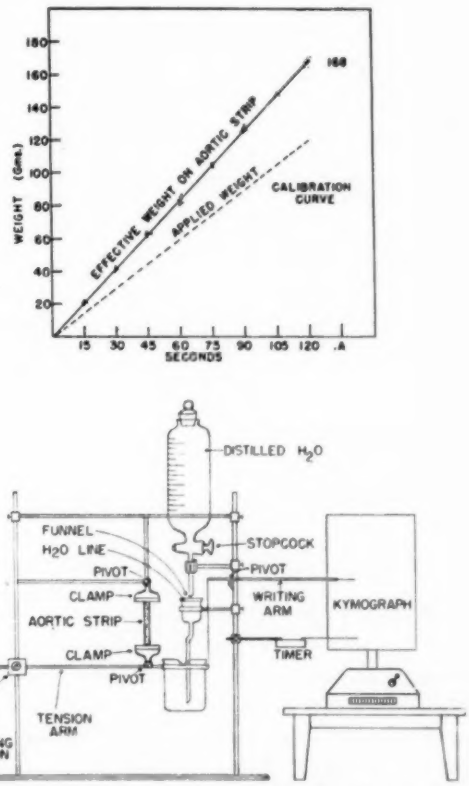


FIG. 1. Diagram of apparatus and calibration curve.

Certain quantitative details in the design are as follows: (1) The delivery rate was 84 gm. water/min., 0.3 gm. (2) The proportions of the lever arms in the recording device gave a magnification of twentyfold. (3) The timing could be determined to within 0.8 per cent. (4) The time lag between the recording system and the load was the same as in the calibration curve

* From the Experimental Surgery Branch, Naval Medical Research Institute, and Tissue Bank, Naval Medical School, National Naval Medical Center, Bethesda, Md. The opinions expressed herein are those of the authors and are not to be construed as official or as necessarily expressing the views of the Department of the Navy, or the Naval Service at large.

and therefore does not introduce an error. (5) The cross section area of the aortic strip was found to be subject to considerable uncertainty; successive determinations occasionally differed by 10 per cent. (6) Creeping was less than 4 per cent per fifteen minutes at 150 gm. and may be considered as insignificant over a two-minute period.

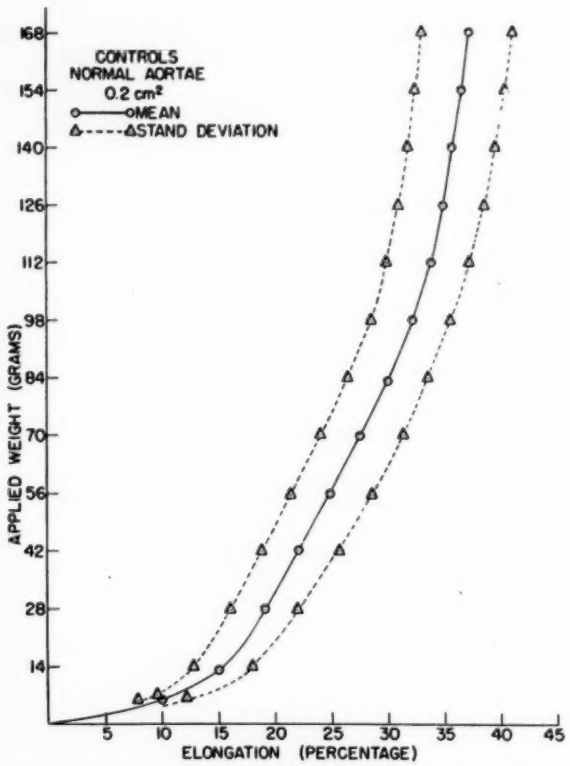


FIG. 2. Weight vs. elongation curves for normal aorta.

Analysis of Data. The weight vs. elongation curves were plotted on arithmetic graph paper. In order to allow direct comparison between all specimens, regardless of the thickness of any particular vessel, the curves were then replotted using figures for the elongation calculated on the basis of a standard cross sectional area of aorta. The cross sectional area while under tension was calculated from the original volume and the measured length, assuming a constant volume system. (See Appendix.) All the curves shown have been so obtained and represent the elongation corresponding to a given weight applied to an aorta with a cross sectional area of 0.2 cm².

The Young modulus for each of various points along the curves was calculated using:

$$M = \frac{W \times L \times 980}{A \times el}$$

where W = effective applied weight (gm.)
L = unstretched length (cm.)
A = cross-section area (cm².) (under W load)
el = elongation (cm.)

Since the modulus of the aorta varies with the tension, the tension is specified by subscript, as

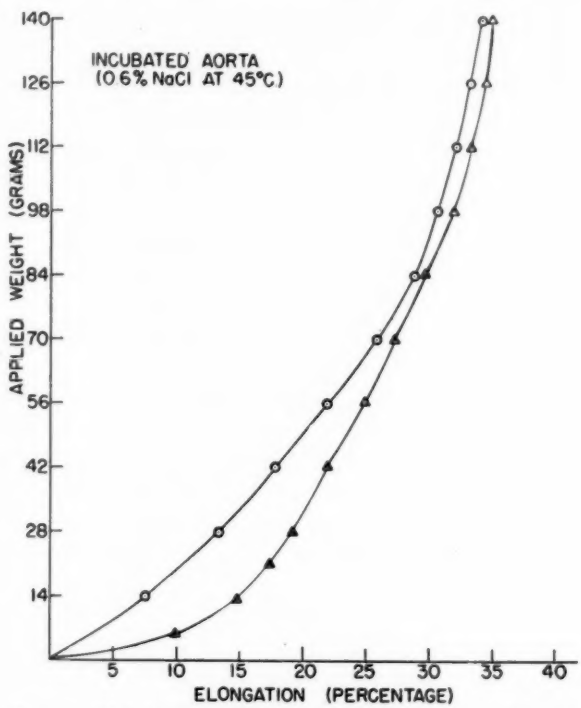


FIG. 3. Weight vs. elongation curve for normal aorta (triangles) and incubated muscle-free aorta (circles).

M_{50} (Young's modulus calculated with a weight of 50 gm. applied to the aorta). Because of the aforementioned experimental variations the values given in the results must be considered as relative and not as absolute.

RESULTS

The mean weight vs. elongation curve of fifty determinations on thirty fresh normal aortic strips is shown in Figure 2 together with the standard deviations. Other investigators have obtained a similar pattern.[8–10] The principal difference to be noted lies in the region of low tension range. This region is marked by changing behavior with repeated tests.

The characteristics of a strip after incubation in 0.6 per cent NaCl for seventy-two hours at 45°C. is shown in Figure 3. Histologic studies showed destruction of muscle cells without

visible effects on the elastic or collagen fibers. The treated segment exhibits about 30 per cent increase in total length of the unstretched aorta. There is no difference between the curves of first and subsequent stretches of such specimens.

investigators.[8–10] It seems reasonable to expect analysis of the elasticity curves to indicate the contribution of the individual tissues of the aorta. The differences observed between the initial and subsequent stretches for aorta are usually attributed to smooth muscle tone,[1,8–10]

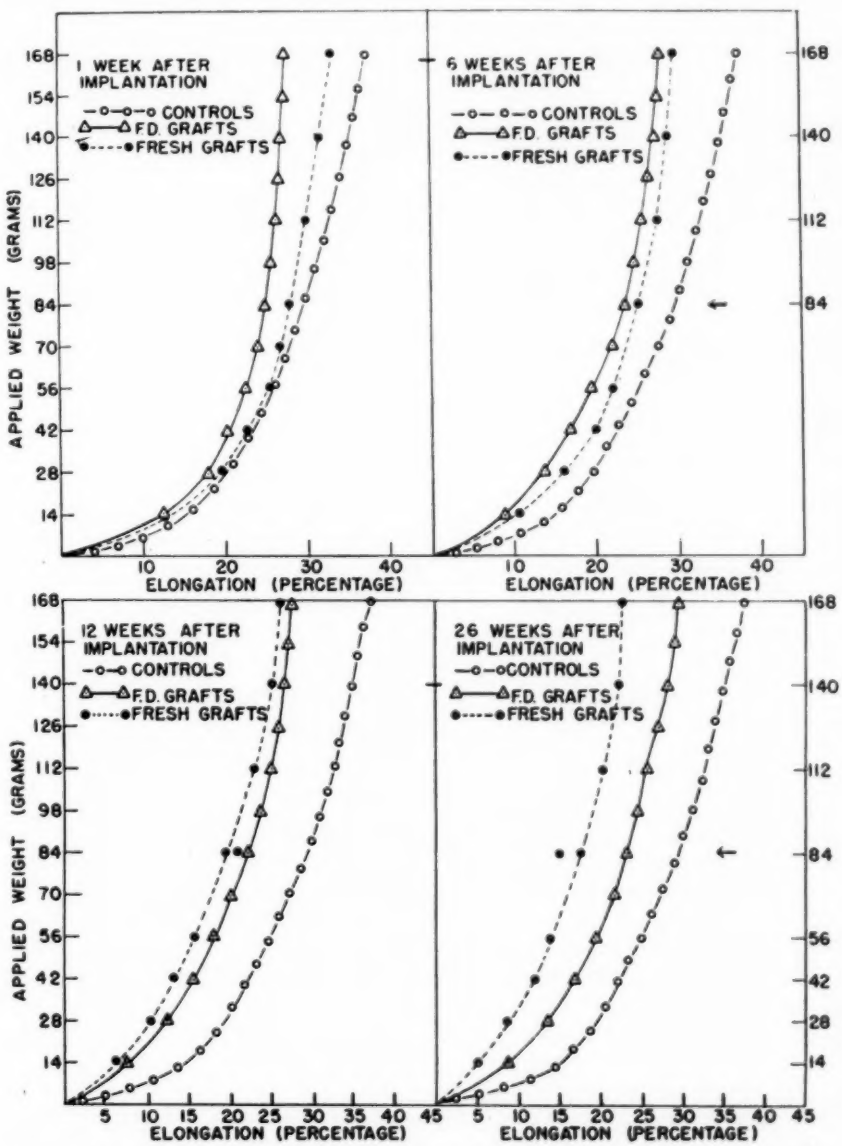


FIG. 4. Weight vs. elongation curves for fresh and freeze-dried aortic grafts after various periods of implantation (means).

The characteristics of two types of grafts, fresh and freeze-dried, together with the properties of fresh controls are shown in Figure 4. Table 1 presents a summary of the elasticity observations together with certain histologic details.

COMMENTS

Fresh Artery. The elongation curve in Figure 2 is similar to that obtained by other

since the elasticity of the aorta in this region of the curve can be shown to be altered by the action of epinephrine and also by the destruction of the muscle cells. Therefore minor differences between other reported curves and these, in the low tension ranges, may be due to the deep sodium pentobarbital anesthesia of the donor animals with resultant change in muscle tone. The differences between first and

subsequent stretches at 28 and 42 gm. weight represent about 20 per cent of the total elongation at these tensions. The relationship which this transient value may bear to tension conditions normally existing in the arteries of the animal is not known, but the fact that it ex-

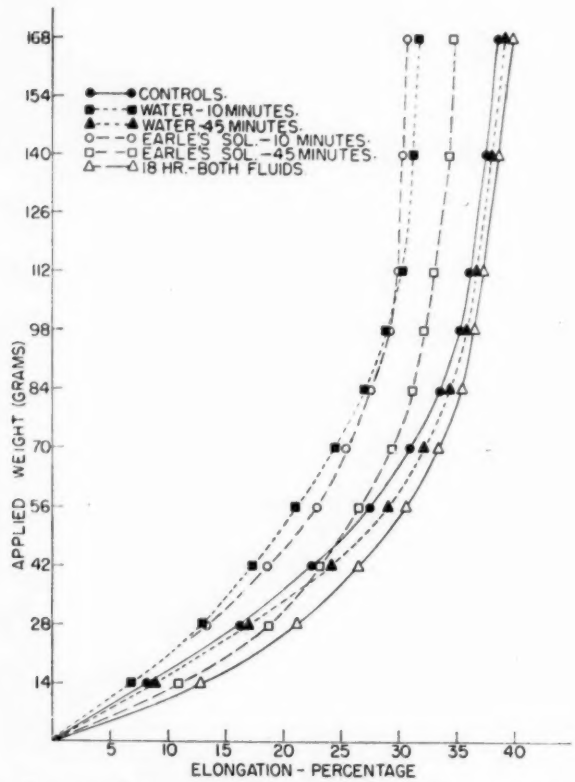


FIG. 5. Curves for freeze-dried aortic segments (mean storage time, six months), after reconstitution in water or Earle's solution for ten minutes, forty-five minutes and ten hours.

ists and can be measured after extirpation provides a basis for comparison between the controls and the grafted segments.

The upper more vertical part of the curve approaches the slope of the curve of relatively inextensible collagen fibers. The middle regions of the curve have a slope similar to that of elastic fibers. Other investigators have also attributed this portion of the curve to elastic fibers since it closely resembles the curve of ligamentum nuchi.

Grafts. The fresh graft one week after implantation yields an elasticity curve distinguished with difficulty from that of the fresh control strip. The curve progressively changes from one week to one year. (Fig. 4.)

The difference between elongation produced in initial and subsequent stretches by 28 and 56 gm. weight of fresh grafts is within the limits of experimental error, indicating *no* significant difference between the first and subsequent stretches. This is interpreted as indicating an absence of functioning muscle cells. There is at high tensions a progressive increase

TABLE 1

Period of Implantation (wk.)	Type of Graft	Muscle-cell Destruction	Invasion of Grafts	Perivascular Fibrosis	M_{14}	M_{56}	M_{168}
1	Fresh	0–1	0	0	1.1	2.0	5.0
	Freeze-dried	4	0	0	1.1	2.4	6.0
6	Fresh	3–4	1	2	1.2	2.4	5.6
	Freeze-dried	4	2	0	1.5	2.8	6.0
12	Fresh	4	2	3	2.2	3.3	6.2
	Freeze-dried	4	3	1	1.9	3.0	6.0
26	Fresh	4	3	4	2.7	3.8	7.3
	Freeze-dried	4	4	2	1.5	2.8	5.4
				Controls	0.6	1.3	2.7

in slope approaching that of collagen fibers. The loss in elasticity of the graft might be explained by: the loss of only muscle cells with the resultant increase in initial length; by a change in the architectural arrangement of the fibers (not confirmed by microscopic examination); or by the infiltration of fibroblasts with their higher moduli. Table 1 shows the changes in moduli and the important microscopic characteristics are various periods of implantation. The M_{14} represents that portion of the curve usually attributed to smooth muscle, and therefore these two columns should be compared. Likewise, the fibroblastic reaction and invasion should be compared with the M_{56} and M_{168}. It is to be noted that there is an increase in the modulus, denoting increased stiffness, as fibroplasia progresses.

Before reconstitution the freeze-dried grafts are friable and inelastic. Very shortly after being placed in reconstituting fluid, however, the freeze-dried grafts begin to regain their elasticity. The rate of this elastic return depends upon the reconstituting fluid. Figure 5 demonstrates typical changes in elasticity as the graft is reconstituted in distilled water or physiologic salt solution with plasma added (Earle's solution).

The absence of significant differences between the first and subsequent stretches of freeze-dried grafts, both before and after implantation, is interpreted as an absence of functional muscle cells.

The freeze-dried grafts show a large initial loss of elasticity at one week after implantation. No muscle cells are seen on microscopic examination. The absence of muscle cells has been shown to be responsible for about a 25 to 30 per cent decrease in unstretched length. By correcting for this loss of length the curve can be superimposed upon that of the fresh strip, except for the curved portion, which is also attributed to muscle cells. Thus there is fairly good agreement between the elasticity studies and the histologic appearance. There is relatively little increase in stiffness later, correlated with the small amount of perivascular fibrosis.

Both fibroblastic invasion of the graft and perivascular fibrous reaction lead to a deposition of collagen, but not of elastic tissue. Collagen is relatively stiff so that increase in collagen should be reflected in an increase in modulus. The rigidity measured by the elasticity curves appears to be determined primarily by the perivascular reaction. It is to be noted that there is a trend toward an inverse relationship between the perivascular fibrosis and the fibroblastic invasion. This indicates that the inert grafts which do not stimulate excessive perivascular fibrosis are invaded more rapidly. The fibrous tissue organized about the elastic fibers during invasion does not produce as much stiffness as does fibrous tissue throughout the adventitia. This brings up the problem of the effects of fiber arrangement on elasticity. Whether they are in parallel or series would affect their elasticity. It seems that the organized arrangement among the elastic fibers is more desirable. Fertile fields for more study are the determination of the exact architecture of aorta, affects of pulsatile flow on the elasticity curves and a study of the elasticity characteristics of individual component fibers.

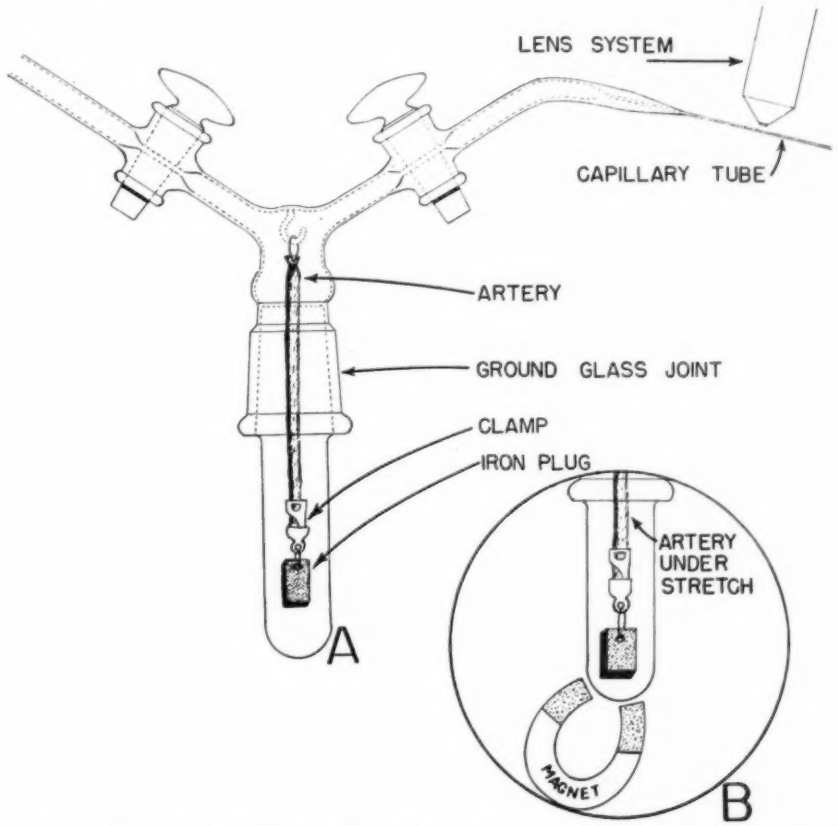


FIG. 6. Apparatus for determining volume changes with tension. A, minimal tension on vessel; B, tension applied with magnet and volume change noted by observing, through lens, movement of the saline-air interface.

CONCLUSIONS

The weight vs. elongation curves of fresh grafts show progressive loss of elasticity until stabilization occurs about six months after implantation. This loss of elasticity coincides with muscle degeneration, fibroblastic infiltra-

tion and particularly perivascular fibrosis. However, the freeze-dried grafts undergo a very rapid initial loss of elasticity which seems correlated with the more rapid muscle degeneration and fibroblastic infiltration. After this initial change the curve stabilizes, showing little change later, being nearer normal than the fresh grafts.

From the data obtained in this study, insofar as elastic properties are concerned, a freeze-dried arterial homograft is as good as and possibly better than a fresh homograft. Whether or not this prediction of the fate of the grafts, after years of implantation, will prove to be accurate must await long-term follow-ups.

Appendix. The correction of the assumption of constant volume was tested. A chamber was constructed into which an artery could be placed under tension within a measurable volume. (Fig. 6.) The artery strip was suspended by a small piece of metal and the chamber filled with normal saline, being careful to exclude all air and leaving a water-air interface in the (0.1 mm. diameter) capillary tube. The apparatus was allowed to assume a stable temperature in an air-conditioned room. The artery was then stretched by applying a strong magnet to the outside of the chamber while watching the interface through a simple microscope. (Fig. 2.) A volume change of less than $\frac{1}{1000}$th that of the artery can be detected with this apparatus. It was demonstrated that there was no detectable change in the volume of the artery caused by stretching.

REFERENCES

1. Krafka, J., Jr. A heretofore unrecognized mechanical principle effective in aortic sclerosis. *Arch. Path.*, 34: 965–970, 1942.
2. Pate, J. W., Bachelor, W. H., Sawyer, P. N. and Sewell, W. H. Freeze-dried aortic heterografts. (In press.)
3. Pate, J. W. and Sawyer, P. N. Freeze-dried aortic grafts. A preliminary report of experimental evaluation. *Am. J. Surg.*, 86: 3, 1953.
4. Pate, J. W., Sawyer, P. N., Deterling, R. A., Jr., Blunt, J. A. and Parshley, M. Early results of the experimental use of freeze-dried arterial grafts. *S. Forum, Am. Coll. Surgeons*, pp. 147–151, 1952.
5. Sawyer, P. N. and Pate, J. W. Intravascular thrombosis of electric origin. *Armed Forces M. J.*, 4: 23–30, 1953.
6. Sawyer, P. N. and Pate, J. W. A study of electric potential differences across the normal aorta and aortic grafts of dogs. (In press.)
7. Sawyer, P. N. and Pate, J. W. Further studies in the relationship of abnormal and injury electric potential differences to vascular thrombosis. (In press.)
8. Krafka, J., Jr. Changes in the elasticity of the aorta with age. *Arch. Path.*, 29: 303–309, 1940.
9. Krafka, J., Jr. Comparative study of histophysics of aorta. *Am. J. Physiol.*, 125: 1–14, 1933.
10. Remington, J. W., Hamilton, W. F. and Dow, P. Some difficulties involved in the prediction of the Stoke volume from the pulse wave velocity. *Am. J. Physiol.*, 144: 536, 1945.

SPASTIC AND HYPERTROPHIC SPHINCTER MECHANISMS

LEWIS E. SCHOTTENFELD, M.D.

Brooklyn, New York

FOR some time numerous articles have appeared in the literature referring to certain disease entities centering around a commonly known sphincter mechanism, especially the sphincter of Oddi and the pyloric sphincter.[32] A variety of medico-surgical therapeutic measures have been proposed, none with uniform results, which is probably because the fundamental origin of these conditions still requires further clarification. The possibility that there may be some underlying common denominator affecting all or most of these has only recently been suggested by Wangensteen.[9] In addition to the sphincter of Oddi and the pyloric, the other sphincters or sphincter-like mechanisms are the cardioesophageal, in connection with which the clinical entities cardiospasm (described by Mickulicz in 1882) and megaesophagus (described by Hacker in 1907) have been described; the rectosigmoid junction, associated with the condition of megacolon or Hirschsprung's disease; and the ureterovesical, the hypertrophy of which results in megaureter.

These sphincter or sphincter-like mechanisms are under the control of the autonomic nervous system and are apparently designed to serve as regulatory mechanisms which they do under normal conditions. However, when the autonomic nervous system control is interfered with as in the degeneration or loss of ganglion cells in Auerbach's plexus, the resultant dystonia causes troublesome conditions to develop. This is demonstrated by the experiments of Kling,[25] by the work of Swenson[29,30] in megacolon and Herbst[26] in pyloric stenosis in infants. It can also occur when the sphincters respond to abnormal stimuli and may become hypertrophied, as in biliary dyskinesia and adult hypertrophic stenosis.

Sphincter of Oddi. This is a definite anatomic sphincter.[3] When it becomes hypertrophied and abnormally spastic, the pressure within the common bile duct, as shown by Butsch and McGowan[6] and others, may increase up to four or five times normal. Biliary dyskinesia is the basis of two related conditions, namely, postcholecystectomy syndrome[4,5,7,10] and chronic relapsing pancreatitis, whose importance received its impetus from Doubilet and Mulholland,[20] and Colp.[27,28] Both conditions have been the subject of much debate and some misunderstanding from the standpoint of etiology and therapy. Much of the original work on surgery around the sphincter of Oddi is found in the writings of the French and South American authors.[11]

In the majority of these cases the fault is primarily in the hypertonic and/or hypertrophied sphincter of Oddi. The postcholecystectomy syndrome, as the name implies, occurs in those cases in which the gallbladder has been removed but where the primary trouble was not in the gallbladder but in the hypertonic sphincter. The gallbladder disease with or without calculi was secondary as the result of the bile stasis with or without infection. Unquestionably, a diseased gallbladder, especially with cholelithiasis, must be removed; but if a hypertonic and/or hypertrophied sphincter of Oddi is the primary cause, it will still be present and the symptoms may be even worse after cholecystectomy because the increased intraductal pressure can no longer be shared with the gallbladder. The cause of this hypertonicity may be either gastric hyperacidity producing sphincteritis or it may be caused by disturbances in the central and autonomic nervous systems or by excessive alcohol and other irritating substances as in many cases of chronic relapsing pancreatitis. This occurs especially in those patients whose sphincters are susceptible to such irritating influences.

Medical treatment such as bland diets, antacids, antispasmodics[2] and restriction of irritating substances may help. However, in many cases, especially those associated with persistent infection in the common duct which may result in the formation of new common duct stones, surgery must be performed.[24] Surgical procedures are of two types. In the indirect approach the sphincter is by-passed,

as in choledochojejunostomy[8] or choledochoduodenostomy over a T-tube to maintain a wide stoma. A direct approach to the sphincter appears preferable: choledochostomy is performed and also duodenostomy to visualize the ampulla of Vater.[31] Bakes' dilators are passed downward through the common duct opening or probes are passed upward through the ampulla of Vater. The sphincter is then cut longitudinally over a probe. One should not be content with this. A wedge of the sphincter should be excised to insure patency, prevent fibrous stenosis and allow a free flow of bile. A Cattell long-arm T-tube should be inserted from above to come out into the duodenum. The duodenostomy should be securely closed transversely and reinforced with silk, and the common duct opening closed over the Cattell T-tube. This tube should remain in several months to allow complete healing and fibrosis to take place. There is no harm in leaving a tube in for six months or more if necessary. The concept of ascending infection through such a tube has been overemphasized. Cutting the sphincter of Oddi with a sphincterotome passed through a common duct opening, as advocated by Doubilet and Mulholland,[20] is not advisable because it is done blindly; it does not insure proper cutting of the sphincter, does not insure against fibrous stenosis of the cut sphincter with stricture formation and it lends itself to the possibility of injuring an anomalous blood vessel which may result in hemorrhage.

Chronic relapsing pancreatitis frequently results from previous acute episodes of pancreatitis and is frequently preceded by biliary tract disease and biliary dyskinesia.[13] In fact there may be cases diagnosed as postcholecystectomy syndrome which in reality are recurrent attacks of pancreatitis. Proper investigation will usually determine the difference. Chronic relapsing pancreatitis manifests itself in various degrees from mild attacks to severe fulminating catastrophies and from moderate edema of the gland to fibrosis, calcification, cyst formation, pancreaticolithiasis and diabetes. The diagnosis may be made by serum amylase determinations, pancreatic responses to secretin, cholangiograms and by x-rays.[20] Chronic relapsing pancreatitis is more prone to occur in those patients whose common bile duct and duct of Wirsung ends in a common channel at the end of which is the sphincter of Oddi. Here again it is an abnormal sustained spasm with or without hypertrophy of this sphincter which causes the attacks of pancreatitis and its possible sequelae because of reflux of bile into the pancreatic duct. The modus operandi is too well known to repeat here. As in cases of postcholecystectomy syndrome, the direct approach to the sphincter is preferred, namely, a transcholedochal sphincterotomy under direct vision through a duodenostomy followed by insertion of a long-arm Cattell T-tube which enters the duodenum and is maintained for several months. Other methods of treatment have been tried by others with varying results, i.e., thoracolumbar sympathectomy,[21] splanchnic blocks followed by splanchinectomy, partial or total resection of the pancreas,[14] subtotal gastrectomy and vagotomy,[22] choledochojejunostomy[8] and paravertebral and epidural procaine block.[14] Cases associated with calcification and pancreatic lithiasis may require lithotomy or pancreatectomy.[14] The treatment for the other complicating manifestations of chronic relapsing pancreatitis is too well known to require repetition.[18]

Pyloric Sphincter. Overactivity and hypertrophy of this sphincter is manifested in two conditions, hypertrophic pylroic stenosis[19,23] in adults and hypertrophic pyloric stenosis in infants. There are some who say that the former is a carry-over from a remission stage of the latter but there are numerous cases on record which started in adult life and in which there was never any history of infantile disturbance. This discussion is confined to the adult type.[12]

The predominant features in the majority of these cases is pain and the presence of a tumor as the result of hypertrophy of the sphincter. Clinically there is evidence of obstruction, gastric dilatation and retention of barium. That this condition may also be based on dystonia as a result of abnormalities in the nerve cells of Auerbach's myenteric plexus finds some support in the work of Charlotte Herbst (1934) who found such instances in hypertrophic pyloric stenosis of infants. There is a strong analogous relationship between this condition, megaesophagus and megacolon.

The treatment for this condition is surgical only. Two procedures stand out as the only adequate ones to effect a cure with excellent

results; a Heinecke-Mickulicz pyloroplasty or a subtotal or partial gastrectomy. Of late the tendency has been toward gastrectomy. The following two cases are examples of this condition:

S. B., a thirty-eight year old woman, was admitted to the hospital on February 10, 1948, complaining of generalized abdominal pain. She gave a five-year history of epigastric and right upper quadrant pain occurring after meals. She had been treated for gallbladder disease and for an ulcer. Two gastrointestinal series were interpreted as showing a duodenal ulcer, the last one with marked retention. In the last six months she had lost 22 pounds in weight. Several forms of dietary treatment had failed to alleviate the symptoms. She was admitted because of a severe attack of pain. She was prepared for surgery for three days, during which time her symptoms subsided. The blood chemistry and work-up were normal.

At operation the pylorus and pyloric sphincter were found to be markedly hypertrophic and enlarged. The other organs were normal. A gastrotomy was made in the pyloric antrum. Finger exploration revealed the pyloric canal to be extremely narrowed and hardly able to admit a fine probe. The gastrotomy incision was carried across the pyloric sphincter and partly into the duodenum. A Heinecke-Mickulicz pylorosplasty was done, closing this incision in a transverse manner.

The patient had an uneventful recovery. She was permitted out of bed the day after operation and on the ninth day was discharged with the wound healed. She was able to eat everything. At follow-up five years later she was symptom-free, had gained weight and was able to eat everything.

L. N., a fifty-one year old woman, was admitted to the hospital on January 3, 1951, complaining of a choking sensation after eating and that she was able to eat little. For twenty-eight years she had been treated for a duodenal ulcer following a gastrointestinal series, without any relief. She had repeated attacks of pain and ulcer symptoms and in the past year had lost 20 pounds. Recently the attacks had occurred daily associated with vomiting and pain at various times during the day and night. She had had an appendectomy and hysterectomy. Physical examination showed no abnormality, and the blood chemistry and work-up were within normal limits. The patient was prepared for surgery.

At operation numerous adhesions were found. The pylorus and pyloric sphincter were thickened and hypertrophied, and on manipulation became more spastic and blanched. There was no evidence of ulcer or neoplasm. A procedure similar to that used in the previous case was performed; the pyloric sphincter was cut across longitudinally from the pyloric antrum to the duodenum and then closed transversely. In addition, an anterior gastrojejunostomy was performed.

Biopsy of the pyloric sphincter was reported as negative for any pathologic condition.

The patient made an uneventful recovery and was discharged ten days postoperatively, symptom-free and able to eat everything. At follow-up twenty months later she was asymptomatic and able to eat all foods.

Cardioesopbageal. That an actual sphincter exists here has been stated by some and disclaimed by others; but when the sphincter or sphincter-like mechanism is in force and results in the condition known as megaesophagus (Hacker, 1907), definitive treatment becomes mandatory. Cardiospasm (Mickulicz, 1882) is another condition which has defied numerous attempts toward treatment in many cases.[1,16,17]

Pain is the outstanding symptom in both conditions. Vomiting frequently occurs in both and marked dilatation of the esophagus is, of course, pathogenic of the former. These conditions are closely associated with malfunction of the autonomic nervous system because, just as in megacolon or Hirschsprung's disease, a marked diminution or absence of ganglion cells in Auerbach's myenteric plexus has been reported and corroborated by numerous writers. Because of this autonomic nerve imbalance the term achalasia was applied by Hurst (1915), and more recently the term dystonia by Wangensteen[9] because there is an upset in the physiologic law of peristalsis of Bayliss and Starling. An important differential point should be kept in mind between megaesophagus, which is on a disturbed functional basis with no inflammation of the wall of the esophagus, and peptic esophagitis, in which no dilatation takes place because of the inflammatory reaction and because it occurs in patients with an ulcer diathesis. Also, whereas a high subtotal gastrectomy will cure most cases of peptic esophagitis, this procedure will not cure megaesophagus.

Numerous explanations of the pathogenesis involving the esophagocardiac segment have been proposed, most of which cannot pass careful scrutiny. The only one which is supported by evidence is the neuromuscular dysfunction of the lower segment of the esophagus due to degeneration or absence of ganglia in the myenteric plexus of Auerbach. This presumably impedes the vagal inhibitory impulses and permits the sympathetic motor impulses to act unchecked. Therefore the lower end of the esophagus fails to relax with each peristaltic wave as it normally should with a physiologically functioning autonomic nervous system. The vagus as the parasympathetic nerve and the sympathetic as its counterpart are part of this system. However, the fundamental cause of this absence of ganglia is still unknown. Pharmacologic treatment to offset the action of the sympathetic has been unsuccessful. Dilatation with esophageal bougies has been of only temporary value. The same applies to other forms of treatment; only the surgical treatment remains.

Many procedures have been tried in megaesophagus and cardiospasm which have been more or less discarded, such as cutting various nerve trunks, i.e., sympathectomy, vagotomy and phrenicoexeresis.[15] Operations directed against the constricted segment at the esophagocardiac junction began in 1904 with Mickulicz, who attempted digital dilatation of the constriction through a gastrotomy. Wendel in 1910 tried open cardioplasty.[9,15] Heyronsky (1913) and Grondahl (1916) encountered difficulties in their esophagogastrostomy type of anastomosis which was accompanied by a high percentage of esophagitis, a serious complication which seems to follow most of the procedures. However, the procedure which has withstood the test of time and experience as giving the best results and the least incidence of esophagitis is the Heller (1913) esophagocardiomyotomy operation.[9,15] This is performed in the manner of the Ramstedt operation for hypertrophic pyloric stenosis in infants. Recently Wangensteen,[9] recognizing the hazards of esophagitis, attempted to eliminate the two sources of this complication, namely, the hydrochloric acid of the stomach, and the bile and pancreatic secretions. He performs an esophagogastric resection, leaving only the pyloric antrum which he anastomoses to the resected end of the esophagus; in addition to this he performs a Ramstedt type of pylorotomy to prevent regurgitation of bile and pancreatic secretions. He reserves this radical procedure mainly for the more advanced cases of atonic megaesophagus and utilizes an approach through a sternotomy incision.

Rectosigmoid Junction (Colocolonic). Although an actual sphincter is not present at this juncture, the presence of some localized hypertrophy of the circular muscle fibers has been mentioned occasionally. This of course is highly conjectural. Megacolon or Hirschsprung's disease, long considered refractory to many kinds of treatment, has in the past few years been clarified by the work of Swenson et al.[29,30] who reported a segment of constriction at this junction which was due to the absence of ganglion cells in Auerbach's myenteric plexus. This caused an impediment to the normal intestinal flow and resulted in the area of constriction and hypertrophy above which the colon ballooned out characteristically. One of the great contributions to surgery has been Swenson's operation for this dystonia, in which he resects the constricted area and pulls down and sutures the proximal colon to the anus.

Although Swenson's operation has gained great popularity, the excellent results obtained with the Heller myotomy in megaesophagus and its analogous use in infantile hypertrophic stenosis have caused an interest in the application of this procedure in megacolon by some surgeons, such as Correia-Netto[9] and Graham, with fairly good results especially in youngsters. In fact, Correia-Netto has performed this operation in over thirty cases. It has the advantage of simplicity over the Swenson operation but care must be exercised not to perforate the mucosa; the entire constricted area must be included in the myotomy and postoperatively no manipulation through the rectum should be done, such as enemas and sigmoidoscopic examinations, because of the danger of perforation through the pouting mucosa.

Ureterovesical. The ureter enters the bladder obliquely, passing through the muscular layer of the bladder. Where it passes through, there is a sphincter mechanism which prevents the backflow of urine when the bladder is full. Under certain conditions a definite sphincter is present which becomes hypertrophied and functions abnormally. A megaureter results which may go on to hydronephrosis.

Very little need be said about the other

sphincter or sphincter-like mechanisms mentioned at the beginning of this paper, namely, the cystocholedochal and cervicouteral, because disturbances in them occur very rarely. Wangensteen has suggested the use of the myotomy operation for the ureterovesical constriction and for biliary dyskinesia. Very little experience has been reported with this procedure in either of these conditions; and until such time as a sufficient number of cases accumulate to form some judgment as to the efficacy of myotomy in these conditions, a worth while opinion cannot be expressed. One might venture to say that because of the anatomic arrangement myotomy would be effective and safe in the ureterovesical type of case, but would be frought with some danger in biliary dyskinesia where the direct approach to the sphincter as described heretofore is safer and more permanently effective.

SUMMARY

Attention is called to the presence in the body of a group of sphincter or sphincter-like mechanisms with or without hypertrophy. These seem to have as their primary function some regulatory control for the passage of secretions, excretions and food from one hollow viscus to another. It appears that disturbances in the autonomic nervous system control, as reflected in degeneration or absence of ganglia in Auerbach's myenteric plexus, results in functional obstructive phenomena. In the study of a large series of cases in Brazil Etzel found some cases that had a combination of megaesophagus, megacolon, megaureter and achalasia of the pylorus. From these, certain conditions ensue which bear the names of well known disease entities which for many years have responded poorly or not at all to a variety of medical and surgical therapeutic measures. It is advocated that a direct attack on these sphincter or sphincter-like mechanisms would yield the best results in the manner described herein.

REFERENCES

1. Kay, E. B. Surgical treatment of cardiospasm. *Ann. Surg.*, 127: 34, 1948.
2. Eisenstein, M. and Necheles, H. Pharmacology of the sphincter of Oddi. *Gastroenterology*, 9: 576, 1947.
3. Thiessen, N. W. The anatomy of the sphincter of Oddi. *Am. J. Surg.*, 53: 94, 1941.
4. Carter, R. F. Benign fibrous stenosis of the common duct. *Am. J. Surg.*, 30: 110, 1935.
5. Zollinger, R., Branch, C. D. and Baily, O. T. Instrumental dilatation of the papilla of Vater. *Surg., Gynec. & Obst.*, 66: 100, 1938.
6. Butsch, W. L. and McGowan, J. M. Pressure in the common bile duct. *Proc. Staff Meet., Mayo Clin.*, 11: 145, 1936.
7. Pribram, B. O. C. Postcholecystectomy syndrome. *J. A. M. A.*, 142: 1262, 1950.
8. Bowers, R. F. and Greenfield, J. Choledochojejunostomy; its role in the treatment of chronic pancreatitis. *Ann. Surg.*, 134: 99, 1951.
9. Wangensteen, O. H. A physiologic operation for mega-esophagus: (dystonia, cardiospasm, achalasia). *Ann. Surg.*, 134: 301, 1951.
10. Mallet-Guy, P. and Blondet, P. Surgical possibilities in treatment of migraine of biliary origin. *Lyon chir.*, 45: 307, 1950.
11. Congress on Gastroenterology. Foreign letters. *J. A. M. A.*, 144: 198, 1950.
12. Bockus, H. L. Gastroenterology. Philadelphia and London, 1944. W. B. Saunders Co.
13. Probstein, J. G. Acute pancreatitis: questions and answers. *S. Clin. North America*, pp. 1457–1463, 1950.
14. Warren, K. The control of acute and chronic pancreatic pain. *S. Clin. North America*, pp. 873–883, 1950.
15. Hawthorne, H. R. and Davis, H. C. Esophagocardiomyotomy versus esophagogastrostomy in the surgical management of intractable achalasia. *S. Clin. North America*, pp. 1669–1682. 1951.
16. Sweet, R. H. Idiopathic dilatation of the esophagus. *S. Clin. North America*, pp. 1128–1135, 1947.
17. Fritz, J. M., Clark, D. E. and Adams, W. E. Diagnosis and treatment of cardiospasm. *S. Clin. North America*, pp. 173–187, 1951.
18. Rhoads, J. E., Howard, J. M. and Moss, N. H. Clinical experiences with surgical lesions of the pancreas. *S. Clin. North America*, pp. 1801–1816, 1949.
19. Schroeder, C. M. Hourglass stomach caused by annular muscular hypertrophy. *Ann. Surg.*, 130: 1085, 1949.
20. Doubilet, H. and Mulholland, J. H. Recurrent acute pancreatitis: observations on etiology and surgical treatment. *Ann. Surg.*, 128: 609, 1948.
21. Connolly, J. E. and Richards, V. Bilateral splanchnicetomy and lumbodorsal sympathectomy for chronic relapsing pancreatitis. *Ann. Surg.*, 131: 58, 1950.
22. Richman, A. and Colp, R. Chronic relapsing pancreatitis: treatment by subtotal gastrectomy and vagotomy. *Ann. Surg.*, 131: 145, 1950.
23. North, J. P. and Johnson, J. H. Pyloric hypertrophy in the adult. *Ann. Surg.*, 131: 145, 1950.
24. Cole, W. H. and Grove, W. J. Persistence of symptoms following cholecystectomy with special reference to anomalies of the ampulla of Vater. *Ann. Surg.*, 136: 73, 1952.
25. Kling, F. W. Motor functions of the cat's colon following excision of Auerbach's plexus. *Ann. Surg.*, 136: 162, 1952.
26. Herbst, C. Wesen und Behandlung der Pylorus-Stenose des Säuglings. *Therap. d. Gegenw.*, 79: 295, 1938. (Quoted by W. C. Alvarez: A lack of local ganglion cells in cases of congenital pyloric stenosis. *Gastroenterology*, 16: 787, 1950.)

27. Colp, R. Treatment of post-operative biliary dyskinesia; 8 cases of endocholedochol sphincterotomy. *Gastroenterology*, 7: 414, 1946.
28. Colp, R. and Doubilet, H. Endocholedochol sphincterotomy. *J. Mt. Sinai Hosp.*, 7: 334, 1941.
29. Swenson, O. and Bill, A. H., Jr. Resection of the rectum and rectosigmoid with preservation of the sphincter for benign spastic lesions producing megacolon; experimental study. *Surgery*, 24: 212–220, 1948.
30. Swenson, O., Neuhauser, E. B. D. and Pickett, L. K. New concepts of etiology, diagnosis and treatment of congenital megacolon. (Hirschsprung's disease.) *Pediatrics*, 4: 201–209, 1949.
31. Mahorner, H. Combined supraduodenal and transduodenal exploration of the common bile duct. *Ann. Surg.*, 129: 766, 1949.
32. Schottenfeld, L. E. Spastic and hypertrophic sphincter mechanisms. *Bull. Adelphi Hosp., Brooklyn*, 11: 2–11, 1952.

Radioactive colloidal gold has recently been used intracavitarily in various patients with pleural or peritoneal effusions (ascites) associated with malignancy. Spicer et al. recently used it on nineteen such patients and their results show that half of the patients were improved in that pain and rate of effusion diminished to a moderate or even a marked degree. There is no definite evidence as yet that life is prolonged or that the malignant cells are actually destroyed although the latter process may actually occur to an extent. At any rate, until something better comes along, the intracavitary administration of radioactive colloidal gold seems worth while. (*Richard A. Leonardo, M.D.*)

CERVICAL AND UPPER THORACIC ESOPHAGOGASTROSTOMY IN THE TREATMENT OF HIGH ESOPHAGEAL CARCINOMA*

MARION B. NOYES, M.D.† AND ROLAND K. IVERSON, M.D.
San Francisco, California

RESECTION of the esophagus for esophageal carcinoma and the immediate establishment of esophagogastric continuity is a major and relatively new procedure. Further evaluation, experience and improved surgical technics are necessary before the status and value of the surgical treatment of this serious disease can be properly determined. We would like to report our experience and concepts derived from a thorough study of the surgical treatment of six consecutive cases of high esophageal carcinoma, and the surgical technics employed in the esophageal resection and establishment of immediate esophagogastric continuity.

We readily admit that the surgical treatment employed in this small series has been primarily of a palliative nature. Although we are definitely in favor of applying and extending palliative surgery in malignancy, we have also been interested in evaluating, gaining experience and improving our technics in this operation with the aim that any increased knowledge, understanding or improved technics gained or developed may be better applied to future cases. Because of the insidious nature of the disease; delayed diagnosis and resultant poor prognosis, the surgeon usually is called into consultation when the treatment must be primarily of a palliative nature. With the rapidly increasing emphasis and knowledge of cancer by both the medical profession and public, the development of an increased index of suspicion and cancer consciousness, the improvement and development of new and better methods of diagnosis and the improving results of treatment, it is hoped that the diagnosis will be made earlier so that definitive treatment and a better prognosis will be available to the patient. Although there is a place for both palliative and definitive surgery in this disease, the most frequent challenging problems now, and in the foreseeable future, will necessarily be primarily of a palliative nature.

Cancer of the esophagus has only recently received the attention which its incidence deserves. It is far from being a rare disease. According to Pack[1,2] carcinoma of the esophagus occurs more frequently than primary malignancy of bone, tongue, larynx or kidney. Czerny[10] in 1877 performed the first successful local resection of a carcinoma of the cervical esophagus. He sutured the distal opening in the lower angle of the wound and used it for feeding purposes. In 1884 von Mikulicz[23] resected the cervical esophagus and successfully fashioned a functioning plastic repair of the fistula. By the year 1908 twenty-five local resections of carcinoma of the cervical esophagus had been performed and reported in the literature, with the high immediate mortality rate of 48 per cent. None of these cases survived longer than sixteen months. Phemister and Adams[29] in 1938 reported a successful resection of the lower esophagus and gastric cardia for carcinoma. It is interesting and yet puzzling to note that, although Brun[2] in 1916 reported a successful resection of the gastric cardia through a transpleural approach, there were only a few sporadic patients with this disease who received surgical treatment during the following twenty-five years and that the majority of these cases were by the cumbersome and generally unsatisfactory Torek type of operation except for Ohsawa's[25] small but significant series reported in 1933 from Japan.

The first five-year survival following a thoracic resection of the esophagus was reported by Torek[34] in 1913. He performed a permanent gastrostomy for feeding purposes and brought the proximal end of the resected esophagus onto the anterior chest wall.

* From the Department of Surgery, U. S. P. H. S. Hospital, San Francisco, Calif.
† Present address 508 East South Temple, Salt Lake City, Utah.

The chief problem associated with subsequent efforts of resection of the thoracic esophagus centered about re-establishment of alimentary tract continuity. By reporting a successful case in 1943 Garlock[16] stimulated interest and demonstrated the feasibility of radical resection of a carcinoma of the thoracic segment with immediate re-establishment of esophagogastric continuity.

It was again because of the pioneering, imaginative and skillful work of Garlock,[15] Sweet[31] and others that in 1948 the first successful cervical esophagogastrostomies were reported. Also by this time other important and successful advances in esophageal surgery had been reported.[1–13,19,22–25,29,34,35]

In reporting our experience with esophageal resection for carcinoma and the immediate establishment of esophagogastric continuity we are purposely limiting the discussion to the upper esophagus and not including our experience with either the lower esophagus or the esophagogastric carcinoma group. Three of our cases required cervical esophagogastrostomy because the lesions were not confined to the cervical esophagus alone, and local resection and tube-flap repair by the Wookey technic was not feasible. Preference has been given, in our cases, to a combined left abdominal and right thoracic approach as first advocated by Ivor Lewis.[22] However, a left thoracic approach was used in one case because it was believed the anastomosis could be made below the arch of the aorta, and in another case because of a large left diaphragmatic hernia which was repaired at the time of the esophageal surgery. Cervical incisions were made when a cervical or subpharyngeal esophagogastrostomy was necessary. Resection of the medial aspect of the clavicle and first rib, as advocated by Sweet[31,32] did not seem necessary in any of these cases, as the superior thoracic aperture seemed adequate to deliver the stomach into the neck without jeopardizing its blood supply or causing undue compression.

A transverse low cervical incision with division of the right sternoclavicular muscle and the strap muscles was used. The exposure and freeing up of the cervical esophagus was performed after completion of the dissection of the thoracic esophagus, but with the right chest open. This dissection, and the delivering and positioning of the stomach into the neck for anastomosis, were greatly facilitated in this way. It also aided in adjusting and correcting the tension and preventing torsion. The anchoring sutures relieving tension of the stomach in the thorax could be better applied when the final position of the anastomosis and stomach were determined.

There are several principles in the operative procedure and technic that warrant emphasis and illustration. In obtaining adequate mobilization of the stomach in order to perform a satisfactory esophagogastric anastomosis either high in the chest or in the neck, several factors are important. Sufficient mobilization of the stomach must be accomplished to bring a viable stomach up through the esophageal hiatus and into a new high position without undue hiatal constriction or tension on the anastomosis. Uncompromised gastric viability can be maintained by the preservation of the right gastric and gastroepiploic vessels and arches, and the preferable ligation of the left gastric artery near its origin from the celiac artery, if the cardia is free of malignancy.

There should be no hesitancy to perform a splenectomy or mobilize the duodenum by dividing the lateral posterior peritoneum along the right border of the duodenum if additional stomach length or further mobilization seem necessary. An indwelling Levin tube facilitates the freeing up of the lower few inches of the thoracic esophagus and abdominal esophagus, and dilatation of the hiatus at the time of laparotomy. It has not seemed necessary to divide the crura in any of our cases; however, one should not be reluctant to do so if a narrowed hiatal opening might produce impaired gastric circulation or undue constriction of the stomach when it is brought up through the hiatus into the chest.

Whether the surgeon elects to perform the esophageal dissection and anastomosis in either the right or left chest, the abdominal technic of gastric mobilization and esophageal hiatal dilatation are the same. However, in freeing up the lower esophagus one should try to avoid perforation of the mediastinal pleura on the side opposite the planned thoracic procedure.

The thoracic esophagus, except for its lower third, can usually be approached more easily and freed up through a right, rather than a left, posterolateral thoracotomy incision, especially if the tumor is at the aortic arch level or above. When the malignancy is high, or the cardia free of tumor, we believe it is best to resect the

lower esophagus near the esophagogastric junction, turning in the distal esophageal stump, and preserving all of the fundus and body of the stomach to secure additional stomach length, provide proper anchoring of it to relieve anastomotic suture line tension, and provide redundant stomach wall to allow encircling and telescoping of the critical esophagogastric line of anastomosis.

The patients in whom carcinoma of the esophagus develops are usually in the older age group and are therefore apt to have one or more of the degenerative diseases. Consequently considerable study, care and preparation are required if they are to be relatively safe risks to undergo the radical and extensive surgery required to eradicate or palliate their malignant disease. Careful and thorough preoperative evaluation and conditioning, digitalization, proper fluid balance and blood replacement, intratracheal anesthesia by a capable anesthetist, antibiotic coverage, and alert, attentive, postoperative care are required. The cardiac status, cardiorespiratory physiology and chest complications must be especially observed. When this is done, one is often surprised how well these patients withstand their surgery.

However, assuming all this is done, the morbidity or survival of these patients often depends more on the success or failure of the esophagogastric anastomosis than on any other factor. The success of the anastomosis in relation to the immediate outcome in this operation is comparable in importance to the success that a safe duodenal closure has in regard to the morbidity and mortality rate in the operation of partial gastric resection.

Hence in performing an esophagogastrostomy, or an esophagoenterostomy, we believe that in addition to adhering to the usual important fundamentals involved in obtaining a successful anastomosis the patient should be protected by supplementary safeguards.

The important fundamentals mentioned as necessary to secure maximum success in any anastomosis are as follows: (1) The preservation of a good blood supply in both component segments at the site of the anastomosis. This problem will vary with the segments involved in relation to their individual characteristics and the surgical technic. (2) The necessity of a clean, relatively sterile field at the anastomotic site, obtained by proper preoperative antibiotic preparation, preoperative cleansing where indicated and possible, and minimal contamination and spillage at the time of operation. (3) Avoidance of tension or weight on the suture line, utilizing the various methods available to prevent and relieve this tension. (4) The advantages of preserving an adequate stomal lumen, especially in end-to-end anastomoses, in an effort to prevent any detrimental effects from postoperative obstruction or stomal edema at the critical site, or subsequent stricture. (5) Careful technic in the performance of the anastomosis obtaining a leak-proof hemostatic effect, avoiding too large a cuff, prevention of purse-stringing effect, unnecessary narrowing, kinking, or twisting of the stoma or component segments. (6) Recognition of the characteristics and peculiarities of the segments or the loops involved, as well as the principles and problems in their anastomosis, realizing the necessity of applying and utilizing the modifications of surgical technics indicated in performing successful anastomoses at various sites.

The importance of the latter remark and also the other factors mentioned are well appreciated in thinking of the technics involved in performing successful pharyngoesophagostomy after total laryngectomy, esophagogastrostomy and esophagoenterostomy, gastroduodenostomy, colocolostomy, choledochoenterostomy, ureterocolostomy, gastroenterostomy and enteroenterostomy. Each one requires special attention or emphasis on certain factors, although the last two anastomoses are the easiest and safest of all because of the ideal bowel texture, blood supply, etc., of the components.

Although the necessity of using special anastomotic technics and the requirement of further anastomotic suture line protection varies with the anastomosis performed, we believe that in general the advisability and importance of applying these additional supplementary factors and safeguards often do not receive the consideration and emphasis they deserve, and that they are especially important at the esophagogastric and esophagoenterostomy sites. It is for this reason we are devoting considerable discussion and illustration to these particular factors, as compared to other points in technic which are either more obvious or well standardized.

Whenever there is tension or weight on the suture line, leakage or breakdown is more

likely to occur than when not only the tension is relieved, but also the suture line is protected by any adjacent, overlying or encircling structure, whether this structure be peritoneum, mesentery, omentum, epiploic fat tabs or other viable structure. Nature herself teaches us this, and also usually is very kind and helpful to the surgeon if her principles are used and if she is given an opportunity to aid us. Whenever there is a junction of two varying segments, be this variance in either size, physiologic function or anatomic character, we find this junction is protected by two or more of the following conditions: (1) an inserting or telescoping junction; (2) a fixation, without tension, of the junction area and component segments; and (3) further protection in the way of additional covering by peritoneum, peritoneal folds or ligaments. These features are well illustrated at several anatomic sites, e.g., the esophagogastric, gastroduodenal, duodenojejunal, ileocecal and ureterovesical junctions. Hence our efforts should be guided by copying or duplicating nature's methods.

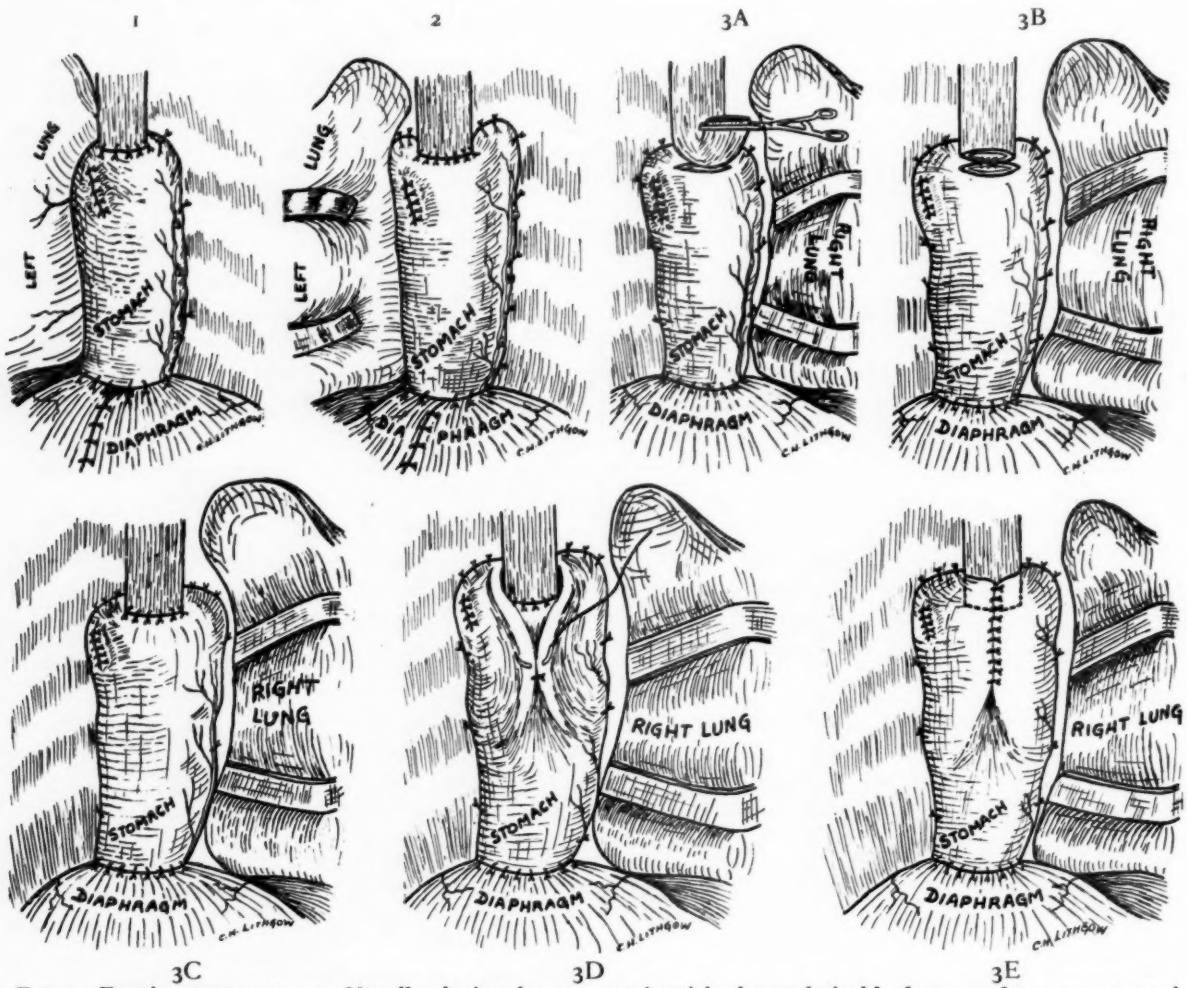


FIG. 1. Esophagogastrostomy. Usually depicted anastomosis with the undesirable feature of an unprotected suture line under tension.

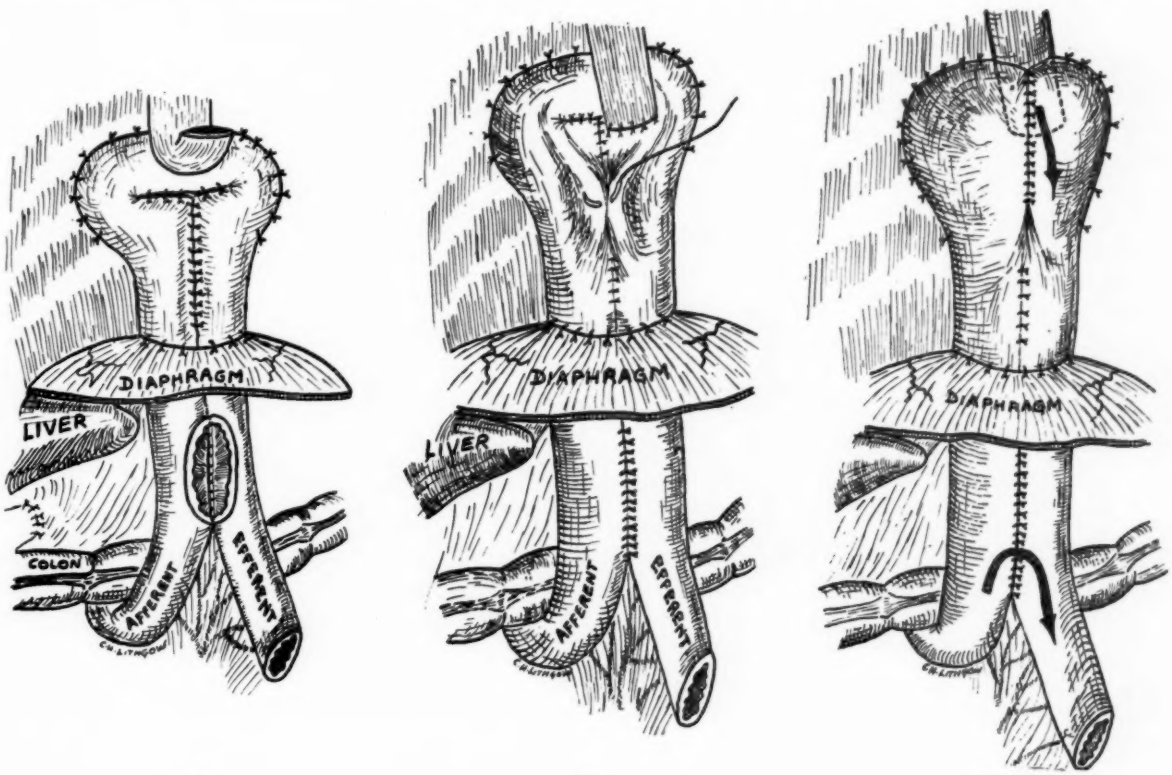
FIG. 2. Esophagogastrostomy. Improved anastomosis with less tension on suture line. Suture line still remains unprotected.

FIG. 3. Recommended esophagogastrostomy. A, stomach anchored to parietal pleura posteriorly above anastomotic level. B, anastomosis partially completed. C, anastomosis completed; suture line protected posteriorly. D, folding stomach wall anteriorly over the anastomosis. E, completed operation; esophagus telescoped between walls of the stomach.

Unfortunately for both the patient and the surgeon the esophagus is devoid of a serosal layer, has a weak muscular layer and a peculiar blood supply. Because of these factors, and

others mentioned previously, leakage at the esophagogastric or esophagoenterostomy suture line is a definite hazard, and more likely to occur than at the suture line of an anastomosis at any other level of the gastrointestinal tract.

In reviewing the literature it is noted that resection of the lower esophagus and stomach, but have not used these procedures for high esophageal anastomoses. We do believe that whenever either of these procedures are used for anastomosis at the distal end of the esophagus, it is best to use either a thoracotomy or



4A 4B 4C

FIG. 4. Esophagojejunostomy. A, afferent and efferent jejunal loops sutured together and tacked to parietal pleura; distal enteroenterostomy partially completed. B, esophagojejunostomy and enteroenterostomy complete; plication of adjacent jejunal walls over esophagojejunostomy. C, completed operation; suture line protected anteriorly and posteriorly.

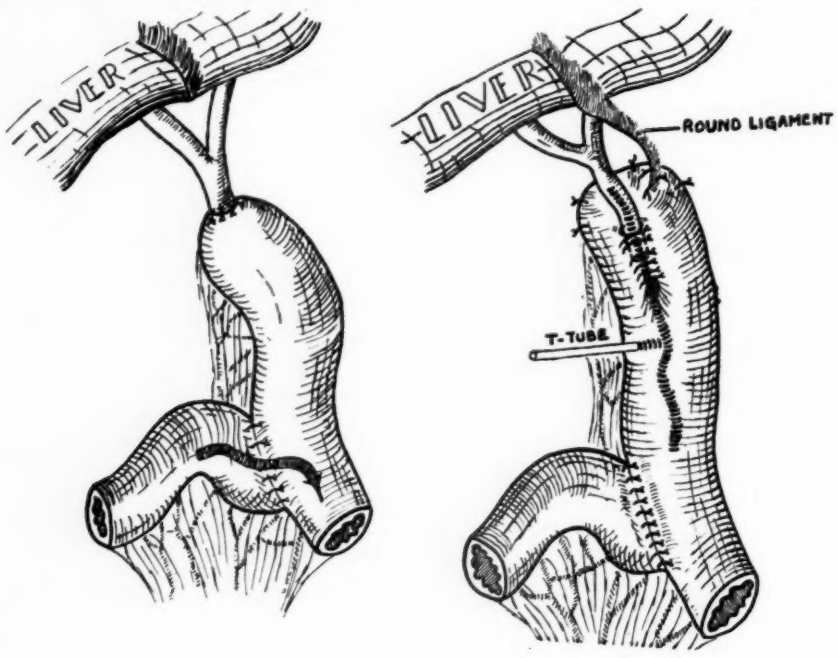
many writers[2–5,14–16,18–22,31–33] have called attention to the importance of relieving tension on the anastomosis because of the vulnerability of the suture line, and also a few others[14–16,18,19,22] have utilized some methods of providing additional suture line protection by using imbrication, or telescoping, or other methods.

In the procedure of anastomosis of the esophagus recommended in this report, all the fundamental principles mentioned are involved and recognized with an effort made to solve the problems by using a modification in technic. We have had considerable experience in using the double jejunal loop applying a modified Graham[18] technic and also the Roux Y[30] principle in reconstruction of intestinal continuity following a total gastrectomy or combined thoraco-abdominal approach and perform the esophagoenterostomy above the diaphragm, using a relatively large complementary enteroenterostomy. Also, by using a little ingenuity, these reconstructive procedures can be modified to include the additional safeguards listed. (Figs. 1 to 6.)

The technic of accomplishing the telescoping of the esophagus between the stomach walls, as advocated and illustrated, is performed in the following manner. The fundus of the stomach is anchored a few centimeters higher than the planned level of the anastomosis. The esophagus is positioned so its posterior wall lies in a central position on the fundus. The new anastomosis is carefully performed using the two layer, fine interrupted silk suture method. The inner layer is a full thickness one

and the more important because the mucoso-submucosal layer is the strong layer of the esophagus. Mattress or strangulating sutures are avoided. The indwelling Levin tube is usually threaded into the stomach after completion of the posterior row. After conclusion of the anastomosis the redundant portion of the fundus is loosely folded anteriorly encircling the esophagus and anastomosis. The stomach wall is anchored to itself and the pleura above. The esophagus and critical anastomotic line now lie like the end of a funnel in a bottle, buried without tension and protected by an intact resilient covering. This procedure, with the anchoring sutures, should be performed so that there is no detrimental obstructing or constricting effect, or jeopardizing of the blood supply. The stomach is further anchored by placing a few fine interrupted sutures, tacking it to the edges of the mediastinal pleura and margins of the hiatus. Few, if any, additional sutures are placed in the esophagus because of the danger of decreasing its blood supply.

Since we started using this method of anastomosis we have been well satisfied with the results in our limited number of cases and plan to evaluate it further by using it orutinely in the future for this anastomosis. We have encountered no obstruction or strictures following its use. It may be applied for an esophagogastrostomy at any level, although at the cervical level one may need to use either the ribbon muscles or a portion of the detached sternomastoid muscle to aid in protecting the anterior aspect of the anastomosis. The cervical incision is drained with a small Penrose drain.



5 6

FIG. 5. End-to-end choledochojejunostomy, Roux Y principle. End-to-end anastomosis of structures with different sized lumens difficult and somewhat hazardous.

FIG. 6. Modified Roux Y technic used in reconstructing biliary intestinal continuity following pancreaticoduodenal resection. Note use of round ligament to support proximal limb of jejunum. Principle may be used in Roux Y esophagojejunostomy.

Although the immediate operative survival rate in this small series has been encouraging, 83 per cent, the long term end results, like those reported in other series, has been discouraging. Reported statistics in the surgical treatment of esophageal carcinoma show considerable variation in regard to both the immediate and late results and a variation in the enthusiasm of the surgical procedure used.[17,20,22,30,33]

CASE REPORTS

CASE 1. P. M. (No. 130090), a seventy-two year old white man, was admitted to the sur-

gical service October 19, 1950, with the complaint of increasing dysphagia of six months' duration. The usual complaint of dysphagia with solid foods, and then liquids, with accompanying substernal pain and later regurgitation was noted, with a weight loss of 17 pounds. Physical examination was essentially normal except for evidence of weight loss. Blood pressure was 120/70. There was no evidence of metastatic disease.

A barium swallow revealed a filling defect below the aortic arch level with distal extension almost to the cardia. On esophagoscopy a large, ulcerating lesion in the middle third of the esophagus was observed. Biopsy confirmed the clinical impression of squamous cell carcinoma. The patient was prepared for surgery.

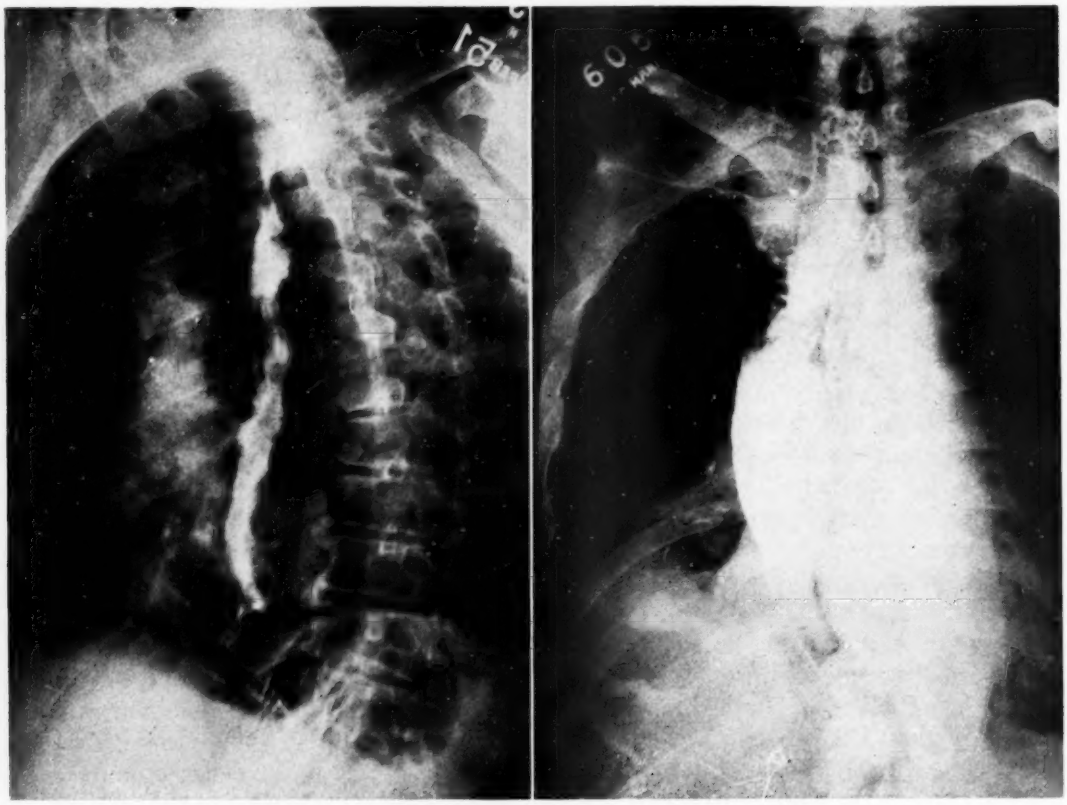
On November 1, 1950, a left posterolateral thoracotomy was performed through the bed of the resected seventh rib with posterior division of the sixth and eighth ribs. Exploration revealed a firm tumor mass in the esophagus extending from 1 cm. below the aortic arch level to the cardia. The growth had extended through the wall posteriorly and there was obvious involvement of the paraesophageal lymph nodes. The mediastinal pleura was opened and the esophagus freed sufficiently to permit an infra-aortic anastomosis. When the diaphragm was split, there was obvious gastrohepatic lymph node involvement but the liver was free of gross metastatic deposits. After excising the involved lymph nodes, the stomach was mobilized and the spleen removed. An infra-aortic anastomosis was performed and the rent in the diaphragm closed leaving an adequate hiatal opening. The phrenic nerve was crushed. The lung was re-expanded and the chest was closed after irrigation and instillation of 300,000 units of penicillin and 1 gm. of streptomycin into the pleural cavity. A No. 26 Foley catheter was employed for drainage. Patient withstood the procedure well.

The postoperative course was smooth. Wangensteen suction was discontinued and the Foley catheter removed from the chest on the fifth postoperative day. Oral feeding was started and rapidly increased to a soft diet. The patient was discharged and did well for two months at the end of which time he began to pursue a rapid downhill course and died soon thereafter.

Comment: A left thoracotomy incision was used in this case because a palliative procedure could be done through the one incision. Postoperatively the patient had no difficulty in eating and was relatively asymptomatic until his final downhill course.

Case II. W. M. (No. 133515), a fifty-nine year old white man, was admitted to the surgical service on February 7, 1951, with the complaint of increasing dysphagia of five months' duration accompanied by substernal pain radiating to the right shoulder, diarrhea, loss of 50 pounds in weight, and one episode of mild hematemesis. Physical examination was essentially negative except for evidence of marked weight loss, emphysema and questionable liver enlargement. Study of the esophagus by barium swallow showed an irregularity of the outline for its entire length and esophagoscopy revealed multiple areas of polyp-like growths in the lumen. Biopsy revealed squamous cell carcinoma. The patient was carefully evaluated and prepared for surgery. (Fig. 7A.)

On March 2, 1951, under balanced intratracheal anesthesia the abdomen was explored through an upper left paramedian incision. The nodes about the celiac axis were involved and tumor masses were palpable in the abdominal esophagus. The stomach and liver showed no evidence of involvement. The stomach and lower esophagus were mobilized after removal of the involved nodes, the hiatus dilated and the abdomen closed. The patient was then positioned for a right posterolateral thoracotomy. The chest was opened through the bed of the resected sixth rib and the fifth and seventh ribs divided posteriorly. The azygos vein was ligated and divided, and the mediastinal pleura opened. The entire thoracic and lower cervical esophagus appeared to be involved with tumor. The thoracic esophagus was freed and the dissection carried well up into the superior aperture of the thorax. Before the chest was closed the cervical esophagus was exposed and freed up above the tumor through a transverse cervical incision. The stomach and esophagus were then pulled up through the esophageal hiatus and the distal esophagus and cardia divided and the latter turned in. The stomach and esophagus were then pulled up through the superior thoracic aperture and positioned for anastomosis. An esophagogastrostomy was performed by the method recommended using the strap muscles to support the anterior surface of the anastomotic area.



7A 7B

FIG. 7. Case II. A, preoperative esophageal carcinoma. B, postoperative esophagectomy and primary esophagogastrostomy at cervical level.

The lung was re-expanded and the chest closed after instilling penicillin and streptomycin into the pleural cavity. A No. 26 Foley catheter was inserted for closed chest drainage. The thoracic and neck incisions were closed and the patient returned to his room in excellent condition. During the procedure 2,000 cc. of whole blood were used.

Postoperatively the patient was placed on Wangensteen suction and closed chest drainage. The postoperative course was smooth except for the need of repeated catheter intratracheal aspiration of tracheobronchial secretions for the first three days. The pleural catheter was removed on the fifth postoperative day and the Levin tube on the seventh postoperative day. Oral feedings were begun at this time. Two weeks postoperatively a small fistula developed in the cervical incision and at the site of the esophagogastric anastomosis. This fistula responded to conservative measures and closed spontaneously. (Fig. 7B.)

The surgical specimen showed an ulcerating, polypoid lesion involving almost the entire length of the esophagus. The pathologic diagnosis was squamous cell carcinoma with metastatic involvement of the regional nodes.

After discharge from the hospital the patient lived comfortably for three months, being able to eat any and all types of food without difficulty. In the fourth month he began to lose weight and noted extreme weakness and easy fatigability, and shortly before death he complained of abdominal pain. An autopsy revealed extensive metastatic carcinoma of the thoracic and retroperitoneal lymph nodes and involvement of the liver and omentum.

Comment: At the time of operation this patient had obvious far advanced malignancy and only a short palliative result was expected. His preoperative symptoms were so severe that we felt any palliation he might receive was worth while. The resection of the lesion and re-establishment of esophagogastric continuity required three incisions. The patient and his family were grateful for the palliative result even though it was of short duration.

CASE III. L. B. (No. 135488), a fifty-five year old Negro, was admitted on October 3, 1951, with increasing dysphagia of one year's

duration. On admission he was only able to swallow liquids and this was accompanied by substernal pain. There was a 15 pound weight loss. Six months before, after inconclusive barium studies, the patient had been esophagoscoped twice with negative biopsies and temporary relief following the procedures. Physical examination was essentially negative except for showing an apprehensive patient in good general condition. There was a grade II enlargement of the prostate.

Studies of the esophagus by barium swallow revealed an irregular defect of the proximal third and esophagoscopy demonstrated an ulcerating lesion 15 cm. from the upper incisor teeth. Biopsy showed squamous cell carcinoma. The patient was carefully evaluated and prepared for surgery.

On October 19, 1951, under balanced intratracheal anesthesia, the same incisions and operative technic were employed as described in Case II. There was a firm, globular-shaped tumor involving the upper thoracic esophagus extending proximally through the superior thoracic aperture and involving the cervical esophagus almost to the pharynx. No significantly enlarged lymph nodes were noted in the thorax or abdomen and the stomach and liver appeared free of metastases. A splenectomy was performed to facilitate mobilization of the stomach and esophagogastrostomy performed. The patient tolerated the operative procedure very well and was returned to his room in apparently good condition.

The patient did well for twenty-four hours postoperatively and then suddenly developed acute pulmonary edema and died thirty hours after the operation. Autopsy was refused.

The surgical specimen consisted of almost the entire esophagus and showed gross malignant involvement of the upper thoracic and cervical portions. Histologically the lesion was a squamous cell carcinoma.

Comment: This patient demonstrates the difficulty frequently encountered in the early diagnosis of carcinoma of the esophagus. In retrospect one wonders if further attempts and persistence might have aided, even though biopsies were reported as negative. Also, a sense of false security was perhaps developed because of marked relief of symptoms obtained by the patient following esophagoscopy.

Case IV. J. O. (No. 136623), a fifty-five year old Japanese seaman, was admitted on December 31, 1951, with a one month's history of rapidly increasing dysphagia, progressing to the extent that only liquids could be swallowed. There was accompanying substernal pain and a 25 pound weight loss. Physical examination was essentially normal, except for evidence of recent weight loss. There was no evidence of metastatic disease.

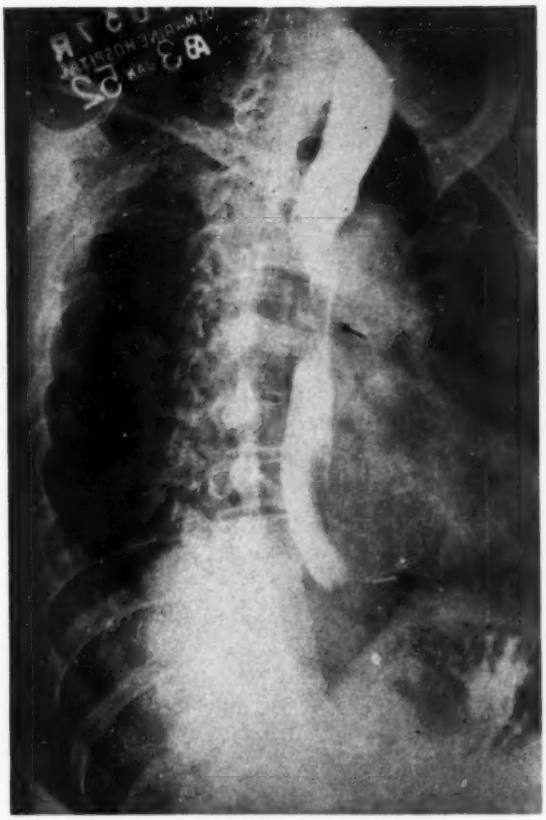


Fig. 8. Case IV. Esophageal carcinoma at arrow.

Barium studies showed a constant filling defect in the middle third of the esophagus, and esophagoscopy revealed a fungating tumor mass 20 cm. from the upper incisor teeth. The biopsy showed squamous cell carcinoma. Bronchoscopy indicated the carina was somewhat fixed and angle blunted, but there was no evidence of intrinsic bronchial extension. (Fig. 8.)

On January 11, 1952, under intratracheal anesthesia, an abdominal exploration was done through a left paramedian incision. There were no metastases. The stomach was mobilized and the hiatus dilated after removing the spleen to facilitate mobilization. The abdominal incision was closed and the patient positioned for a right thoracotomy incision. The pleural cavity was opened through a long posterolateral in-

FIG. 9. Case v. Esophageal carcinoma, upper arrow. Paraesophageal diaphragmatic hernia, lower arrow.

cision through the bed of the resected fifth rib, dividing the fourth and sixth ribs posteriorly. The azygos vein was divided and ligated and the mediastinal pleura opened, exposing the entire thoracic esophagus. A firm tumor of the esophagus was found at the carina level with some extension in either direction and some adherence to the membranous wall of the trachea. No lymphadenopathy was present. We elected to perform a resection of the entire thoracic esophagus. This was performed without difficulty and an esophagogastrostomy accomplished above the tumor high in the chest by the recommended technic. The lung was reexpanded, antibiotics instilled and the chest closed with closed catheter suction drainage. The patient tolerated the procedure extremely well and was returned to his room in very good condition.

The surgical specimen showed a malignancy of the esophagus and histologically the lesion was of the squamous cell variety.

Postoperatively the patient did extremely well and except for one attack of severe dyspnea on the third day, relieved by bronchoscopy and tracheal aspiration, his course was very benign. The pleural catheter and Levin tube were removed on the fourth postoperative day and liquid feedings started. He was eating a soft diet on his seventh day. He was discharged on February 1, 1952, and followed as an outpatient for one month. He was eating a regular diet without distress, gaining weight and free of complaints when he returned to his home in Japan. Further follow-up has been impossible.

Comment: The combination of a left abdominal and a right thoracic approach was very satisfactory in this particular patient. A combined right thoraco-abdominal incision, an approach we intend to use selectively in some of our future cases, might have been just as satisfactory and had the advantage of performing the surgery through a single approach. The resection in this case was probably palliative in nature; however, it appeared fully justified in view of the marked increase in comfort obtained by this patient.

CASE V. F. C. (No. 138332), a fifty-seven year old white man, was admitted on May 7, 1952, with the complaints of one month's rapidly increasing dysphagia, substernal discomfort and a 6 pound weight loss, and stated he was unable to swallow solid food because it would "hang-up at one spot." Seven months before he had been hospitalized for jaundice and cirrhosis, and was a known alcoholic. Physical examination revealed an asthenic patient but otherwise was essentially normal with no evidence of metastases discernible.

Esophageal studies by barium swallow revealed a persistent defect at the level of the second and third dorsal vertebrae. There was also a large paraesophageal hernia noted. Esophagoscopy showed a tumor mass in the lumen of the esophagus at the level seen on x-ray. The biopsy showed squamous cell carcinoma. The patient was carefully evaluated and prepared for surgery. (Fig. 9.)

On May 16, 1952, under intratracheal anesthesia, a left thoracotomy was performed so that the large diaphragmatic hernia could be repaired at the time of the esophageal surgery. Mobilization of the stomach was especially easy because it had already become accustomed to occupying an elevated position in the chest. A cirrhotic liver was noted. The thoracic esophagus was freed up for its entire length. The tumor mass involved the level of the

esophagus occupying the superior thoracic inlet and extended above and below for several inches. There was invasion through the entire thickness of the esophageal wall. With the chest open and a cervical approach, the tumor was freed up, the esophagus resected, and an esophagogastric anastomosis performed in the neck by the method recommended here. The diaphragmatic hernia had been repaired by one of the surgical team while the cervical approach and dissection was made by the other. The incisions were closed in the usual manner, placing a small, soft, Penrose drain subcutaneously in the cervical incision. Patient returned to his room in good condition.

Postoperatively the patient did well. A small cervical fistula developed at the anastomotic site on the eight postoperative day. This healed gradually on conservative management. The patient became ambulant, was able to eat regular food and felt fairly well for a while, except for weakness. During his third postoperative month he rapidly declined and expired. Autopsy revealed a severe cirrhosis of the liver, bronchopneumonia and metastatic carcinoma in the mediastinal lymph nodes.

Comment: A left thoracic approach was used here because of the complicating large diaphragmatic hernia. The stomach was easily mobilized after splitting the diaphragm because of its already elevated position. The mobilization of the esophagus from under the aortic arch is noticeably more difficult from the left than from the right side.

As mentioned in the previous discussion there is a very definite vulnerability of the esophagogastric suture line developing leakage and fistulas. This has occurred so often and been recorded in the literature so frequently that it is now a well recognized fact. Unless the additional safeguarding suture line protecting factors are used, and sometimes in spite of them, this leakage problem will always be a serious factor in esophageal surgery. Every surgeon who has performed this type of surgery is aware of this danger.

The seriousness and complications, however, vary with the location of this anastomosis. Although a leak, and fistula, are more apt to occur when the anastomosis is at the cervical level, it does not usually have the serious import that leakage does when it occurs in either the chest or abdominal levels. At the cervical level, because of the protection afforded the anastomosis by the surrounding compact structures, the close proximity to the external body surface, and with the antibiotic protection, there is a decreased tendency to serious complications like mediastinitis. The leak is inclined to wall off and remain localized, often spontaneously breaking through the cervical incision, producing a fistula that will usually respond to conservative drainage and treatment, just as they do when occurring following pharyngoesophagostomy after total laryngectomy. Leakage or anastomotic line breakdown in the chest or abdominal cavities will result in either an empyema, or subdiaphragmatic abscess or peritonitis, and are likely to produce very serious morbidity and mortality effects.

Case VI. C. R. (No. 141835), a sixty-two year old white woman, was admitted on February 27, 1953, with the complaints of increasing dysphagia, substernal pain and discomfort with recent episodes of severe pain with lateral radiation, occurring with and without swallowing and change in position. There was some weight loss. The symptoms were of an increasing degree over a two-year period and the patient noted that it required a much longer time to eat a meal. She gave the typical and all too familiar history of esophageal carcinoma, in which the patient automatically compensates for the obstruction and pain, and thereby increases the delay in diagnosis, the sequence of dysphagia with solid foods, adjustment to this by better mastication and washing down of the food with liquids, shift to a soft diet, then a liquid diet, and only then, seeks medical consultation. The past history was essentially negative, except she had experienced multiple fractures and had bronchitis and asthma. Two years previously she had a cholecystectomy performed as an emergency for cholelithiasis and gangrenous cholecystitis. Physical examination revealed a well developed white female in very good nutrition. There were several old operative scars and mild asthmatic breathing and wheezing were noted. Blood pressure was 130/75. No evidence of metastases were found. The patient was carefully evaluated and prepared for surgery.

Esophageal studies by barium swallow and esophagoscopy had revealed a constricting, malignant lesion at the aortic arch level. Biopsy was reported as showing squamous cell

carcinoma. Bronchoscopy, chest x-ray and electrocardiogram were reported as essentially normal. Laboratory tests showed a moderate anemia.

On March 10, 1953, laparotomy was performed by the usual approach. No evidence of metastatic disease was found. The stomach was mobilized and esophageal hiatus adequately dilated. The incision was closed and patient positioned for a right thoracotomy incision. The right chest was opened through the bed of the resected sixth rib, dividing the fifth and seventh ribs posteriorly. The azygos vein was ligated and divided and mediastinal pleura opened. The thoracic esophagus was freed up well above the aortic arch and well above the growth. The esophagus was resected and an esophagogastrostomy performed high in the apex of the chest by the technic described herein. The lung was re-expanded, antibiotics instilled and the intrapleural space drained with closed suction using a No. 24 catheter.

The surgical specimen consisted of almost the entire thoracic esophagus with an olive-sized malignancy, which had been adherent to the membranous trachea above the carina. A line of cleavage had been developed allowing fairly easy dissection at this site, with no evidence of perforation noted. No metastases were seen.

The patient withstood the operative procedure well and was returned to her room in good condition. She did very well for twenty-four hours, then marked subcutaneous emphysema developed in her neck and she had some shortness of breath. The patient was digitalized and required several intratracheal aspirations. Her general condition remained good and she rapidly improved. By her seventh postoperative day she was eating a regular diet and emphysema and dyspnea had subsided. Postoperative barium swallow check-up showed a good stoma with no obstruction at the anastomotic site. She was discharged on a regular diet, free of pain, gaining weight, and very grateful for her relief of symptoms.

Comment: This patient exemplifies the smaller, more favorable, apparently slow-growing lesion, yet with all the classic symptoms of obstructive esophageal carcinoma. We believe her prognosis is much better than the others reported here. We think she should have been digitalized preoperatively and wonder if she did have a tracheal leak for a few days. She responded very well to conservative postoperative care.

SUMMARY AND CONCLUSIONS

1. Some of the problems of esophageal carcinoma have been presented and the importance of some of the detailed factors emphasized.

2. A study and evaluation has beem made of six successive cases of high esophageal carcinoma treated by esophageal resection and immediate esophagogastrostomy.

3. This series of patients, admittedly small, was treated surgically in an effort to give palliation for a serious type of malignancy, evaluate the operation of high resection and esophagogastrostomy, gain experience in the procedure, and attempt to improve our technic in the operation so that future cases might receive the benefit of our experience.

4. Certain operative technics have been discussed, with the advantages and disadvantages of each listed.

5. The important fundamental and supplementary factors involved in successful anastomotic technic, based on a wide experience of performing anastomoses at various sites, have been listed with emphasis given for their especial need at the critical esophagogastric anastomosis.

6. When the importance of the many problems associated with this disease and its surgical treatment are understood, the immediate results and operative mortality rate are encouraging. However, the long term end results are disappointing and may be compared to those obtained in pancreatoduodenectomy for carcinoma of the head of the pancreas, and are less encouraging than the results in gastric resection and gastroesophageal resection for gastric malignancy.

7. Carcinoma of the esophagus as usually seen today is a highly malignant tumor, most often first seen when in a far advanced stage, and as such only a palliative result of short duration is possible in the majority of cases.

8. Although at present there seems to be a place for both palliative and definitive surgery by the rather extensive and radical procedures now in vogue, one wonders, when the passage of time has allowed accurate evaluation, if the future will not show the necessity of modifying the present concepts and indications for these procedures. Several alternatives seem possible,

such as: the development of a more thorough cancer eradicating technic; a more careful evaluation and selection of cases for either palliative or possible curative types of surgery; the development of a more simple by-passing procedure for far advanced cases for palliation; or the possible complete abandonment of these extensive procedures in favor of deep x-ray or other conservative forms of treatment.

Acknowledgment: Appreciation is expressed to Drs. Charles H. Lithgow and George Spalding, Surgical Residents, for aid in the illustrations, preparations of manuscript, and photography in this manuscript.

REFERENCES

1. Adams, R. Carcinoma of the thoracic esophagus. *S. Clin. North America*, 24: 684, 1944.
2. Adams, W. E. Surgery of the mediastinum. *S. Clin. North America*, 26: 130, 1946.
3. Adams, W. E. The pathological considerations relating to early diagnosis and curative surgical treatment of carcinoma of the esophagus. *Internat. Abstr. Surg.*, 72: 105, 1941.
4. Adams, W. E., Escudero, L., Aronsohn, H. and Shaw, M. M. Resection of the thoracic esophagus. *J. Thoracic Surg.*, 7: 605, 1937–38.
5. Carter, B. N., Stevenson, J. and Abbott. Experimental esophagogastrostomy. *J. Thoracic Surg.*, 10: 446, 1941.
6. Churchill, E. D. Oesophageal surgery. *Surg., Gynec. & Obst.*, 60: 417, 1935.
7. Churchill, E. D. and Swett, R. H. Transthoracic resection of tumors of the stomach and esophagus. *Ann. Surg.*, 115: 897, 1942.
8. Clagett, O. T. and Root, G. T. Transthoracic resection of the cardia of the stomach. *Proc. Staff Meet., Mayo Clin.*, 19: 187, 1944.
9. Clagett, O. T. and Wiig, L. M. Transthoracic resection of the esophagus and stomach for cancer. *Proc. Staff Meet., Mayo Clin.*, 18: 337, 1943.
10. Czerny, V. Neue Operationen. *Zentralbl. f. Chir.*, 4: 433, 1877.
11. DeBakey, M. E. and Ochsner, A. Subtotal esophagectomy and esophagogastrostomy for high intrathoracic esophageal lesions. *Surgery*, 23: 935, 1948.
12. Eggers, C. Experiences with carcinoma of the esophagus. *J. Thoracic Surg.*, 2: 229, 1933.
13. Eggers, C. Upper esophagostomy. *J. Thoracic Surg.*, 7: 633, 1937.
14. Garlock, J. H. Progress in the surgical treatment of carcinoma of the esophagus and upper stomach. *Surgery*, 23: 906, 1948.
15. Garlock, J. H. Resection of thoracic esophagus for carcinoma located above the arch of the aorta. *Surgery*, 24: 1, 1948.
16. Garlock, J. H. The re-establishment of esophagogastric continuity following resection of the esophagus for carcinoma in the middle-third. *Surg., Gynec. & Obst.*, 78: 23, 1944.
17. Gibbon, J. H., Allbritten, F. F. and Templeton, J. Y. Carcinoma of esophagus and gastric cardia. *J. A. M. A.*, 145: 1035, 1951.
18. Graham, R. R. A technique for total gastrectomy. *Surgery*, 8: 257, 1940.
19. Humphreys, G. H. An approach to resections of the esophagus and gastric cardia. *Ann. Surg.*, 124: 288, 1946.
20. Humphreys, G. H. and Moore, R. L. Carcinoma involving the esophagus. *S. Clin. North America*, 33: 389, 1953.
21. Johnson, J. and Kerby, C. K. Surgery of the Esophagus, Surgery of the Chest, p. 255. Chicago, 1952. The Year Book Publishers, Inc.
22. Lewis, I. The surgical treatment of carcinoma of the oesophagus. *Brit. J. Surg.*, 34: 18, 1946–47.
23. von Mukulicz, J. Ein Fall von Resection des carcinomatosen Oesophagus mit plastischem Ersatz des excidirten Stuckes. *Prog. med. Wchnschr.*, 11: 93, 1886.
24. Ochsner, A. and DeBakey, M. Surgical aspects of carcinoma of the esophagus. *J. Thoracic Surg.*, 10: 401, 1941.
25. Ohsawa, T. Surgery of the esophagus. *Arch. f. jap. Chir.*, 10: 605, 1933.
26. Pack, G. T. Cancer of the Esophagus and Gastric Cardia. St. Louis, 1949. C. V. Mosby Co.
27. Pack, G. T. Introduction to symposium on cancer of the esophagus and gastric cardia. *Surgery*, 23: 867–873, 1948.
28. Payne, J. H. and Clagett, O. T. Transthoracic gastric resection for lesions of cardia of stomach and lower part of esophagus. *Surgery*, 23: 912, 1948.
29. Phemister, D. B. and Adams, W. E. Carcinoma of the lower thoracic esophagus. *J. Thoracic Surg.*, 7: 621, 1938.
30. Reynolds, J. T. and Young, J. P. The Use of the Roux Y in Extending the Operability of Carcinoma of the Stomach and the Lower End of the Esophagus, Cancer of the Esophagus and Gastric Cardia, p. 127. St. Louis, 1949. C. V. Mosby Co.
31. Sweet, R. H. Carcinoma of the superior mediastinal segment of the esophagus. *Surgery*, 24: 952, 1948.
32. Sweet, R. H. Operations on the Esophagus, Thoracic Surgery, p. 228. Philadelphia, 1950. W. B. Saunders Co.
33. Sweet, R. H. The results of radical extirpation in the treatment of carcinoma of the esophagus and cardia with five year survival statistics. *Surg., Gynec. & Obst.*, 94: 46, 1952.
34. Torek, F. The first successful resection of the thoracic portion of the esophagus for carcinoma. *J. A. M. A.*, 60: 1533, 1913.
35. Wookey, H. The surgical treatment of carcinoma of the pharynx and upper esophagus. *Surg., Gynec. & Obst.*, 75: 499, 1942.

DEVELOPMENTAL CYSTS AS A SOURCE OF PERIANAL ABSCESSES, SINUSES AND FISTULAS

WILLIAM J. HAWKINS, M.D.* AND RAYMOND J. JACKMAN, M.D.†
Rochester, Minnesota

FROM time to time patients have been observed who, from symptoms and signs, seemingly have had an ordinary fistula-in-ano, the source of which may have been somewhat obscure. Some of these patients gave histories of recurring abscesses in the perianal region and of persistence of a sinus after repeated incision and drainage. Many of these patients had had definitive surgical treatment in an attempt to cure what, for all practical purposes, was a common fistula-in-ano, but the expected cure had not occurred and there was recurrence of an abscess or a draining sinus. It was then noted that these patients were finally discovered to have some type of developmental cyst as a source of their repeated abscesses and draining sinuses. Following complete extirpation of the cyst, the site of operation healed completely. These observations presented a problem.

In all types of surgery, but particularly in anorectal surgery, it is in general axiomatic that the surgeon who has the first opportunity to correct a pathologic condition usually has the best chance of effecting a cure, providing a cure is attainable. From this standpoint it would be ideal if these developmental cysts could be recognized immediately as the underlying lesion in a patient who has the symptoms and signs of what seems to be a fistula-in-ano. It would follow that such a patient would be spared much discomfort, repeated operations, expense and possibly anal incontinence.

The question then arises: Is there any clue that will point with certainty to such a cyst as the source of a perianal abscess or draining sinus? If such a clue is not available, is there any group of findings that would make the surgeon suspect that a developmental cyst is the probable, or even a possible, source of the infection? If the problem at hand were even suspected initially and the underlying abnormality subsequently searched for, the incidence of cure in this type of anorectal infection would be increased considerably.

That this type of cyst is a possible source of perianal abscesses and infections has been recognized by various authors. Lahey and Eckerson reported on three patients who had presacral developmental cysts. One of these patients gave a history of recurring perianal abscesses and sinuses, and of having had nine previous operations in this region over a period of four years. Following recognition of the real etiologic basis and its total extirpation, cure resulted. Bonser, Raper and Shucksmith reported four cases. Each patient had an epidermoid cyst occurring in the perianal or perirectal region. Three of the four patients had sinuses in the perianal region. These authors also cited twenty-one cases from the literature, in three of which there were perianal draining sinuses. Whittaker and Pemberton reported on twenty-one patients, each of whom had some type of presacral tumor. In nine of the patients the tumor was a dermoid, and of these nine patients two gave histories of incision and drainage of previous abscesses with subsequent draining sinuses.

TERMINOLOGY

The term "developmental cyst" signifies a cystic tumor occurring in the presacral, precoccygeal or perianal tissues, the presence of which is due to some developmental error during the formation of the embryo.

In the cases reported by most authors and also in the records of the cases reviewed herein, the offending lesion was one of three types of cysts, namely, dermoid, epidermoid, or mucus-secreting cyst. It is cysts of these types that most commonly give rise to findings which simulate fistula-in-ano.

There does not seem to be unanimity of

* Fellow in Proctology, Mayo Foundation.
† Section of Proctology, Mayo Clinic.

opinion among teratologists and pathologists as to what histologic structures should be manifest in order that a tumor be called a teratoma, complex dermoid, simple dermoid, epidermoid, sebaceous cyst and so forth. Ewing states that a rigid classification is impossible because one type of tumor will contain structures supposedly found only in another. There is much overlapping of the characteristics of these tumors. Willis classifies them all under one head, teratomas, and each has certain features of the others. Developmental anomalies can be stated to exist as a class, with monsters, parasitic fetuses or fetal inclusions at one end and epidermoid cysts at the other. In between these are tumors which approach and blend or shade toward one extreme or the other.

FIG. 1. The dermoid cyst has been dissected from the presacral and precoccygeal region. A probe is in the funnel-like sinus and an anoscope is in place. *Inset:* The cyst after removal. A probe has been inserted into the sinus and passed through the fistulous tract to communicate with the cyst. There are numerous small mucus-secreting cysts adherent to the outer wall of the fistula.

PATHOLOGIC CHARACTERISTICS

Simple Dermoids. The gross and microscopic picture presented by simple dermoids is well known. Grossly they appear to be soft, occasionally fluctuant, cystic tumors. The size of the dermoid usually depends on the length of time it has been present since it tends to increase in size. The simple, uncomplicated dermoid cysts that occur in the precoccygeal region and that are possessed of a connecting skin sinus do not ordinarily become as large as those that exist without a sinus. The sinus and its tract, confluent with the dermoid, act as a vent to prevent the enlargement that would occur if debris accumulated within the cyst. A dermoid without a draining sinus may become quite large, to the point that it becomes obvious as a tumor presenting on either buttock. The uncomplicated dermoid is usually well encapsulated and surgically can be "shelled" from the habitus of its surrounding tissues with relative ease. (Fig. 1.)

When a dermoid cyst is opened, a variety of findings may be encountered. The contents are usually an oily or soft cheese-like substance in which hair is mixed; there may be predominance of one over the other. The lesion may consist of one single cystic cavity or multiple smaller cysts. Occasionally a tooth may be present, depending on the degree of differentiation that the embryonal ectoderm has undergone. Moore states that at one area of the cyst lining there is a small tubercle 2 to 4 mm. in height. This is called the "germinal tubercle" and from it numerous hairs project; and if a tooth is present, it will be embedded in or project from the tubercle.

Microscopically, since the simple dermoid cyst is ordinarily considered monogerminal in origin, its contents and its walls are composed of tissues associated with the skin and its appendages. The inner lining of the cyst or cysts is composed of stratified squamous epithelium, with sebaceous glands, fat cells, hair follicles and sweat glands within the fibrous tissue wall. (Fig. 2.) Cholesterol crystals are usually present within the contents.

The picture presented by uncomplicated simple dermoid cysts may be altered considerably owing to secondary changes. The most notable of these is infection with subsequent suppuration. Inflammatory reaction may destroy the lining of the cysts, the epithelium being replaced with fibrous tissue. The oily or cheese-like contents may be replaced with pus. The end result may grossly resemble an abscess rather than an embryonic cyst. Usually, however, some of the skin elements remain unchanged, permitting the correct diagnosis. When infection supervenes, the cyst no longer is well demarcated but becomes very adherent to surrounding tissues. Other secondary changes include rupture of the cyst, usually followed by infection, and papillary ingrowth or overgrowth of the dermal structures causing the

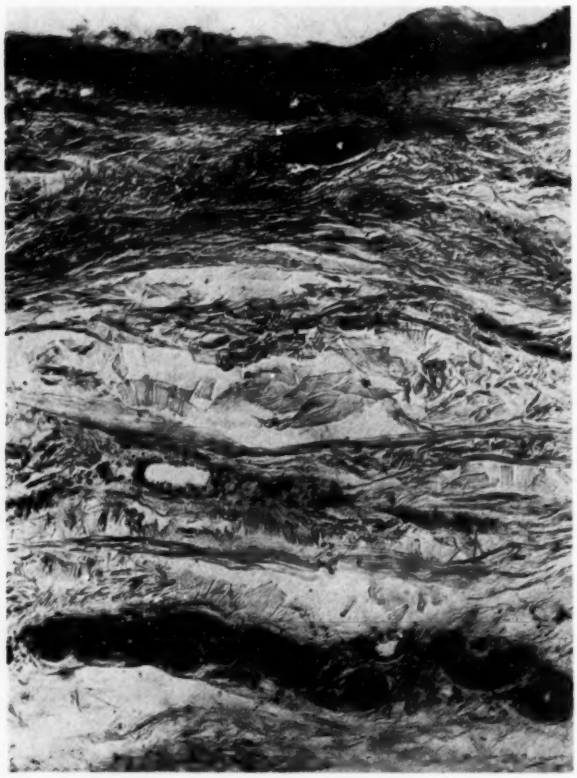


FIG. 2. Wall of a dermoid cyst showing an inner layer of stratified squamous epithelium. In addition there are fibrous tissue, hair follicles, blood vessels and sweat glands (hematoxylin and eosin, × 65).

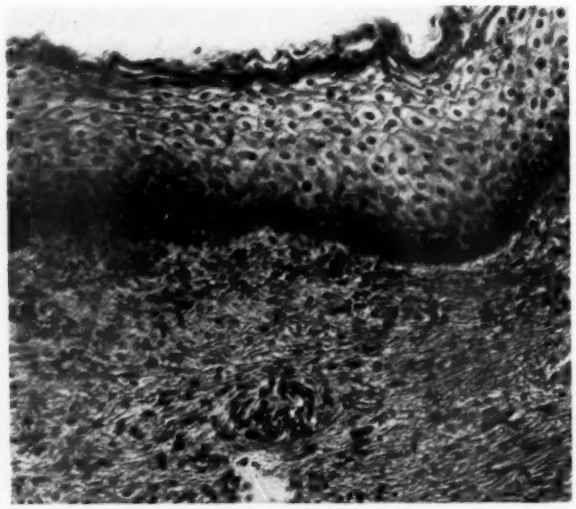


FIG. 3. Wall of an epidermoid cyst showing an inner layer of stratified squamous epithelium but lacking such dermal elements as hair follicles and sweat glands (hematoxylin and eosin, × 165).

cyst grossly to resemble a true tumor rather than a cyst. Finally there may occasionally be neoplastic changes.

Epidermoid Cysts. The epidermoid cyst is distinguished from the dermoid cyst in that definite dermal structures and their appendages are lacking. (Fig. 3.) Because it arises from the epidermis either as a result of trauma or from a congenitally misplaced epidermoid cell, the cells composing the tumor are limited to those of the epidermis and its sequestra of keratinized material. If the basis is a congenitally misplaced epidermoid cell, growth occurs and the resulting proliferation and differentiation take place at approximately the same rate and in approximately the same manner as if the tissue were epidermis on the surface of the body. Nicholson states that the germinal cells of the rete malpighii constantly produce prickle cells which eventually undergo keratinization. Soon after implantation, if the cyst is a result of trauma, dead horny cells form a mass near the germinal layer. This mass acts as an irritant, fibroblasts form and giant foreign body cells make their appearance. The epithelium is stimulated to cover the raw granulations that are in contact with the rest of its circumference, and the germinal cells, therefore, spread along the surface. However, the epithelium is constantly undergoing physiologic differentiation, giving rise to more horny flakes. These accumulate and cause enlargement of the cavity which keeps pace with the effects of the epithelium to surround it. A vicious circle is set up and the epithelial lining never becomes complete.

Most textbooks use the terms "epidermoid cyst" and "sebaceous cyst" synonymously. However, Anderson, and Broders and Wilson have expressed the belief that there is a very definite difference between the two. Sebaceous cysts are thought to be occlusion cysts, while epidermoid cysts are new growths. Broders and Wilson have suggested that they may arise from the ducts of the sebaceous glands or from hair follicles.

Mucus-secreting Cysts. Grossly these are very thin-walled cysts; they tend to be opalescent and may be translucent. They usually contain a clear mucoid material and the cyst walls, when opened, readily collapse. The cysts are usually well demarcated but may be difficult to remove surgically because of the very fragile walls which rupture easily thus making it difficult to recognize them. The cysts may be unilocular or multilocular.

Microscopically the cyst wall is composed of an inner lining of mucus-secreting epithelium

and an outer layer of loose connective tissue and blood vessels. (Fig. 4.)

It is suggested that these cysts may have had their origin from remnants of the neurenteric canal. Inasmuch as the embryonic cells which make up this structure are derived from ectoderm and entoderm, they could give rise to both squamous epithelium and columnar mucus-secreting epithelium.

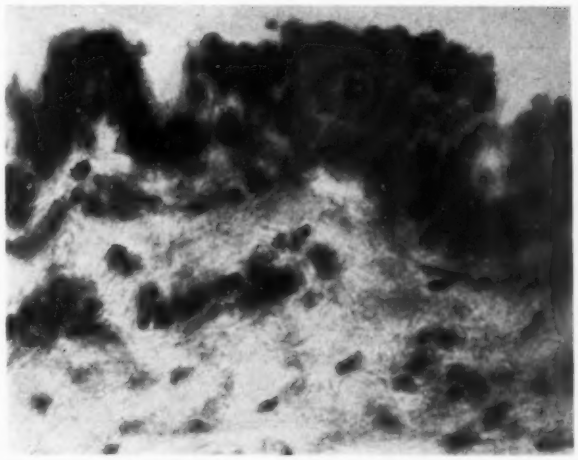


FIG. 4. Wall of a mucous cyst showing mucus-secreting cells (hematoxylin and eosin, × 530).

MATERIAL

The case records of forty patients were selected from those of a large number of patients who, as a general group, had presacral tumors and dermoid and epidermoid cysts, those of the last two categories not necessarily being limited to the presacral or precoccygeal region. These forty cases were selected because in each the surgical diagnosis was presacral or precoccygeal cyst, dermoid, epidermoid or mucus-secreting cyst. The surgical specimens were examined microscopically in all cases and grossly examined when there was a gross specimen available. Special attention was given to the subjective symptoms and the objective findings. Cases in which there were other types of presacral tumors, such as chordomas and complex teratomas, were not included because in no instance did such tumors give rise to findings which simulated fistula-in-ano.

OBSERVATIONS

In the forty cases selected for this study the most striking observation was the predominance of the number of females over the number of males; there were thirty females and ten males giving a ratio of 3:1. In general, these figures are in agreement with those quoted by others.

Nineteen of the forty patients (47.5 per cent) had dermoid cysts, sixteen (40 per cent) had epidermoid and five (12.5 per cent) had mucus-secreting cysts

Of the nineteen patients having dermoids, fifteen were females and four were males, giving a ratio of 3.75:1. Of those who had epidermoid cysts, thirteen were females and three were males, giving a ratio of approximately 4.3:1. The remaining two female patients had mucus-secreting cysts.

The oldest patient in the series was sixty-one years old and the youngest four months. The over-all average age was twenty-nine years. In general, it was observed that most of the patients were young female adults between twenty and thirty-five years of age.

Subjectively there was no one complaint that was common to all patients. Chief complaints ranged from recurrence of perianal abscesses and draining sinuses to those which were entirely foreign to the anosacrococcygeal region.

The complaints of the entire group, listed in the order of frequency of occurrence, were recurring abscesses and draining sinuses, fifteen patients (37.5 per cent); some type of distress referable to the anosacrococcygeal region, seven patients (17.5 per cent); bleeding from the anus or rectum, six patients (15 per cent); presence of a tumor noted by the patient or relatives, five patients (12.5 per cent); constipation, one patient (2.5 per cent); and diarrhea, one patient (2.5 per cent).

The five patients (12.5 per cent) who had no complaints referable to the anosacrococcygeal region underwent surgical treatment because a mass was found in that region on routine examination. It is our policy to advise excision of asymptomatic cysts in this part of the body because the chance of their becoming infected is great, and after infection occurs complete excision may be very difficult or impossible without causing anal incontinence.

Of the nineteen patients who had dermoids, eight (42.1 per cent) complained of having had one or more abscesses. Of those having mucous cysts, one (20 per cent) had this complaint.

It was noted that fourteen of the forty patients (35 per cent) had had one or more

operations. The type of operation performed varied from simple incision and drainage to attempts at definitive surgical treatment.

In our experience objective findings contribute sufficiently to effect a diagnosis of developmental cyst in many such patients. On digital examination of the anus and rectum a mass was discovered in twenty-eight (70 per cent) of the patients in our series. In five the mass was discovered on routine examination, the patients being subjectively unaware of anything wrong in the anorectal region. As stated previously, it is thought wise to excise such cysts regardless of the presence or absence of symptoms.

The presence of a sinus was noted in nineteen patients (47.5 per cent). Five of these patients were not aware that a sinus existed. One of the five patients had a sinus which presented inside the rectum; the remaining four had an inactive sinus. The sinus was located just posterior to the anal verge and the term "dimple" was applied to it. When one recalls the embryology of the region, remembering the embryogenesis of the coccygeal fovea and the filum terminale and the resulting pull on the skin of the area, it seems possible to account for this "dimpled" appearance. It has been observed that the sinus appears to be more like a funnel than a dimple. This funnel appearance is particularly noted if circumferential traction is applied to the skin surrounding the sinus. (Fig. 1.) Comparison of this appearance with that of a fistula resulting from infection, the source of which is an infected anal crypt, discloses that the skin opening of the latter is usually flush with the surface and may exist anywhere in the perianal area, perineum or buttocks. Also, a tuft of granulation tissue may or may not be present. The sinus opening of a developmental cyst seems to have a "congenital" or "dimpled" look about it, whereas the secondary opening of a fistula-in-ano has an "acquired" look.

It is admittedly difficult to determine the underlying pathologic process in those patients who have undergone ineffectual surgical treatment with subsequent reinfection and scarring. If a congenital, funnel-like sinus opening did exist originally, it would of necessity have lost that appearance. Examination under anesthesia will occasionally reveal the true source of the sinus in these patients, but often, as occurred in patients of our series, only "feeling one's way" through the surgical procedure will uncover the true lesion.

As has been stated, nineteen of the forty patients presented anosacrococcygeal sinuses of some variety. The remaining twenty-one patients did not have any anorectal complications associated with the developmental cyst. The only finding that this group had in common with the nineteen patients who had sinuses was the objective evidence of a presacral or precoccygeal mass. In all of these the mass was removed and there was subsequent healing. However, of the nineteen patients who presented sinuses, some gave histories of previous ineffectual surgical treatment and others had asymptomatic sinuses and precoccygeal masses.

CONCLUSIONS

1. Certain conclusions can be formulated from the foregoing study of developmental cysts. There is no single clue, either subjective or objective, that will point with certainty to developmental cyst as the source of a perianal abscess or draining sinus. It is thought, however, that a presumptive diagnosis of cyst can be made on the basis of the following points: (1) a history of recurring perianal abscesses and sinuses; (2) a history of previous, sometimes repeated, surgical attempts to cure such abscesses and sinuses; (3) the presence of a sinus, if uncomplicated by infection, with a funnel-like dimple located just posterior to the anal verge; (4) the presence of a precoccygeal or presacral mass; (5) the extrusion of hair or cheese-like substance or both from the anus or perianal sinus; and (6) the predilection of females to suffer from developmental cysts.

2. These cysts are not common but the incidence is perhaps considerably higher than is usually thought.

3. At times the diagnosis can be established only with the patient under anesthesia, or by surgically uncovering the true lesion.

4. In general, effective treatment consists of total extirpation of the cyst.

5. Recognition of these cysts as a source of fistulas will do much toward preventing repeated surgical procedures with subsequent postoperative morbidity and possibly anal incontinence.

6. Asymptomatic cysts discovered on routine examination of the rectum should be removed surgically since the chance of their becoming

infected is great, in which event surgical treatment becomes much more difficult and the results are less satisfactory.

REFERENCES

1. Anderson, N. P. Cysts, sinuses and fistulas of dermatologic interest. *J. A. M. A.*, 135: 607–612, 1947.
2. Bonser, G. M., Raper, F. P. and Shucksmith, H. S. Epidermoid cysts in the region of the rectum and anus, a report of four cases. *Brit. J. Surg.*, 37: 303–306, 1950.
3. Broders, A. C. and Wilson, E. Keratoma: a lesion often mistaken for sebaceous cyst. *S. Clin. North America*, 10: 127–130, 1930.
4. Ewing, J. Neoplastic Diseases: a Treatise on Tumors, 4th ed. pp. 1042–1072. Philadelphia, 1940. W. B. Saunders Co.
5. Lahey, F. H. and Eckerson, E. B. Presacral dermoids. *Am. J. Surg.*, 23: 30–35, 1934.
6. Moore, R. A. A Textbook of Pathology; Pathologic Anatomy in Its Relation to the Causes, Pathogenesis and Clinical Manifestations of Disease. Philadelphia, 1945. W. B. Saunders Co.
7. Nicholson, G. W. deP. Studies on Tumour Formation. St. Louis, 1950. C. V. Mosby Co.
8. Whittaker. L. D. and Pemberton, J. deJ. Tumors ventral to the sacrum. *Ann. Surg.*, 107: 96–106, 1938.
9. Willis, R. A. Pathology of Tumours. St. Louis, 1948. C. V. Mosby Co.

Saccular aneurysms of the aorta (usually syphilitic) are often amenable to excision. Recently Bahnson excised several such localized sacs from various parts of the aorta, with excellent results. After excision the mouth of the sac is closed. The portion of aorta from which the sac arose is left intact but is closed with two rows of sutures. This restores aortic continuity. In such cases excision is superior to the older methods of ligation, wiring, endoaneurysmorraphy and use of fascia or plastic materials to be wrapped around the aneurysm. (*Richard A. Leonardo, M.D.*)

DUPLICATION OF THE ILEUM*

JAMES J. BURNETT, M.D., RICHARD E. SULLIVAN, M.D., RICHARD C. STEVENS, M.D. AND A. J. TOMSYKOSKI, M.D.

Binghamton, New York

DUPLICATION of a segment of the alimentary tract is a relatively rare condition and the concept of its formation has changed in the past few decades following findings by different observers. Duplications are spherical or elongated hollow structures occurring at any site in the intestinal tract and possessing a muscular coat, usually of two layers, lined with epithelium similar to that of some portion of the gastrointestinal tract but not necessarily to that of the region in which the duplication is located.[1] The lumen of the duplication may or may not communicate with the lumen of the adjacent gastrointestinal tract. However, the duplication is almost always adherent to the adjacent portion of the tract and frequently the muscular coats of the duplication and the gastrointestinal tract are integrated and inseparable. Most cases of intestinal duplication are seen in children and only very rarely in adult life, while the most common clinical features are intestinal obstruction, bleeding of the adjacent intestine or pain from gastrointestinal distention.

Duplications most frequently occur in the region of the terminal ileum[2–4] although they have been reported from the base of the tongue to the rectum.[5] When they are shown roentgenographically, diverticulum is the most likely diagnosis to be made but duplications and diverticula should not be considered as the same thing. At times the duplication may communicate directly with the lumen of the gastrointestinal tract or it may assume the form of a large cyst, making its differentiation from a diverticulum difficult.

CASE REPORT

D. J., a twelve year old white male, was admitted to the Binghamton City Hospital on June 5, 1952, with a chief complaint of right lower quadrant pain of three months' duration. The pain was intermittent in character and lasted from two to four hours, usually developing shortly after meals. The patient usually had associated anorexia but no vomiting and there was no history of hematemesis, melena, constipation or diarrhea. Physical examination was essentially negative except for slight tenderness to pressure in the right lower quadrant. Complete blood count and urinalysis were normal. Since the child was disabled by the symptoms, exploration was decided upon. Exploratory surgery through a right McBurney incision was performed on June 6, 1952, revealing a long, normal appendix and a duplication of the ileum 26 cm. in length which was located 30 cm. from the ileocecal valve. Appendectomy was performed but resection was deferred at this time because the patient was not properly prepared. The postoperative course was uneventful and he was discharged June 17, 1952. He was readmitted on July 17, 1952, and on the following day resection of the segment of ileum and the duplication to which it was intimately attached was performed. A side-to-side ileo-ileostomy was established. The patient did well immediately postoperatively and he has remained asymptomatic since.

Pathologic examination of the specimen revealed a portion of ileum measuring 44 cm. in length with a duplication which extended for a distance of 26 cm. (Fig. 1.) The septum was intact throughout except at a point 4 cm. from the proximal point of the duplication at which site there was a perforation measuring 1 cm. in diameter. Both lumens were lined with mucosa, that of the portion continuous with the small bowel appearing normal whereas the mucosa of the duplication contained small, polypoid lesions. The wall of the duplication was thickened and the lumen measured 1 cm. in diameter and that of the continuous piece of ileum measured 2 cm. in diameter; the mesentery contained many enlarged lymph nodes. (Fig. 2.) Microscopically, the mucosa

* From the Binghamton City Hospital, Binghamton, N. Y.

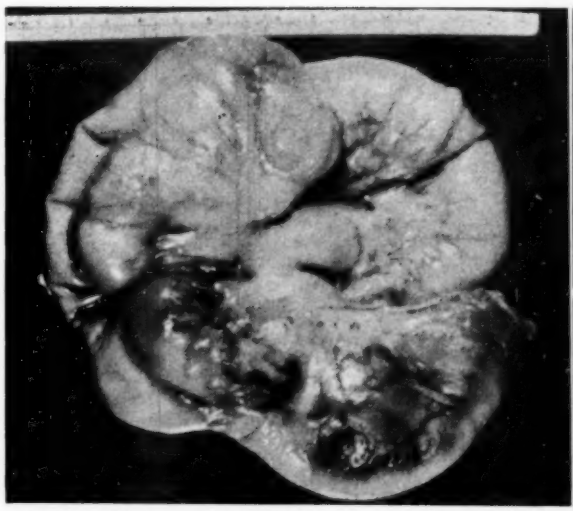


FIG. 1. Picture of resected portion of the terminal ileum showing the duplication adjacent to the ileum before opening.

FIG. 2. Picture of the duplication and ileum following opening of both specimens; note the probe in the communication between the ileum and the proximal portion of the duplication.

of the ileum was relatively normal except for chronic inflammation. There was an abrupt change at the opening of the duplication in which the mucosa at once became gastric in type, characterized by a large number of parietal cells and mucosal hypertrophy.

COMMENTS

Anomalies of the intestinal tract have been grouped by such terms as "duplications" or "reduplications," "enteric cysts" or "enterogenic cysts" and "ileum duplex" or "giant diverticula" with the implication that they all arise in a similar manner from diverticula of the gastrointestinal wall. For some of these anomalies this is a satisfactory explanation but for others such an explanation would not be feasible since the anomaly as described could not, starting as a diverticulum, have attained the form and connections ascribed to it by any known embryologic sequence.

There are many theories regarding the origin of duplication. Early in fetal life the sequestration of embryonal intestinal epithelium may account for the development of the anomalies according to Hughes-Jones.[6] These anomalies have also been attributed by many authors to represent a persistence of the proximal part of the vitelline duct or Meckel's diverticulum. It has been pointed out by Hudson[7] that the persistence of the vitelline duct, which is a normal fetal structure, explains many cysts and diverticula but only for those which occur in relation to the distal portion of the ileum. Likewise this theory would not account for the mesenteric position of the duplications as compared with the constant anti-mesenteric location of Meckel's diverticulum.

Probably the most popular theory of their development is that presented by Lewis and Thyng[8] who described groups of epithelial cells or diverticula, which normally disappear, occurring along the gastrointestinal tract of the embryos of certain animals. It is possible that one of these diverticula may become pinched-off and eventually develop into a duplication.

On the basis of embryologic origin, Bremer[9] has divided these anomalies into two categories, the tubular and the spherical. Most of the tubular structures, and a few of the spherical ones, represent true duplications originating by an abnormal persistence of the vacuoles which are normally present in the "solid stage" of the development of the intestine in the sixth or seventh week embryo. A chain of these vacuoles coalesce to form a new channel alongside the original lumen thus forming a true duplication. Most of the spherical structures are derived from true diverticula which are usually found on the antimesenteric surface of the alimentary tube in embryos of the eighth and ninth week. Normally, these diverticula regress but at times they continue to grow and give rise to the spherical type of duplication.

Although duplications of the gastrointestinal tract can occur anywhere from the base of the tongue to the rectum, the most common site

is along the ileum. Of a total of twenty-four cases reported by Ladd and Gross[5] and Donovan and Santulli,[10] 50 per cent were found to occur along the ileum. In a comprehensive review of the literature, LoPresti et al.[11] found 150 cases of alimentary tract duplication recorded up until 1950 and of these 77 per cent were found in the small intestine. Forty-five new cases of duplication have been reported by Gross, Holcomb and Farber[4] and twenty-one of these were in the ileum. These anomalies may be single or multiple, tubular or spherical, varying in length from a few centimeters to as long as 4 feet. Some of the duplications may communicate with the adjacent normal intestine in one or more places or they may not communicate at all. Usually the tubular, elongated type of duplication communicates with the normal bowel in its distal portion while its proximal portion ends blindly in the mesentery.

At times, the anomaly may be entirely separate from the gastrointestinal tract and then it is referred to as an enteric or enterogenous cyst. More frequently, the duplication is intimately adherent to the normal bowel lying between the leaves of the mesentery and sharing the same blood supply with this contiguous intestine.

The mucous membrane lining the duplication is not necessarily the same as that of the adjacent normal bowel although the structure of the wall of the duplication is similar, consisting of serosa, smooth muscle and mucous membrane. Often the lining mucosa of the duplication resembles gastric mucosa which accounts for the frequent association of ulcers and bleeding, but bleeding may occur from an apparently intact mucous membrane.

Duplications of the gastrointestinal tract are usually found in infants and children but they have also been found in adults. It is of interest to note that most of the duplications have been found in males just as 85 per cent of the reported cases of Meckel's diverticulum are found in males.[12]

Since there are no characteristic symptoms produced by this anomaly, the diagnosis is usually made at the time of operation. Symptoms may never become manifest and duplication may be only an incidental finding at necropsy. Nevertheless, the symptoms at times may be severe. Vague complaints of intermittent abdominal pain may be the only sign or unexplained massive gastrointestinal hemorrhage may be the primary symptom. The abdominal pain may or may not be associated with intussusception of the duplication or it may be part of a volvulus involving the duplication and the adjacent normal bowel. At times an abdominal mass may be palpable. In the cases of bleeding severe anemia may be present and in some instances malnutrition may be an important finding in the clinical picture.

Since the duplication cannot usually be outlined by barium, there are no characteristic findings on x-ray. The diagnosis can be suggested only by displacement of the normal bowel by a viscus containing air which is abnormally situated.

Such conditions as Meckel's diverticulum, mesenteric cyst, intestinal polyposis, hydatid, pancreatic or urogenital cyst, dermoid and teratoma should be considered in the differential diagnosis.

Resection or excision of the duplication should be the treatment in all cases of this condition. Since the blood supply to the duplication is usually common to that of the adjacent normal intestine and because the duplication and the adjacent bowel are intimately attached in the majority of cases, separation is impossible without entering the lumen of the bowel. Simple resection of the duplication is also complicated by the fact that the mesenteric vessels first pass anteriorly and posteriorly to the duplication, which is situated between the leaves of the mesentery, and then supply the distal contiguous normal bowel. Resection of the contiguous bowel is usually necessary and only rarely can the duplication be excised alone when it is entirely separate from the gastrointestinal tract and when the blood supply to the adjacent structures is not hindered. Occasionally, because of the poor condition of the patient, it may be necessary to perform an operation of lesser magnitude such as marsupialization of the duplication or forming a fistulous tract between the duplication and the adjacent normal bowel.

SUMMARY

A case of duplication of the ileum has been presented and the embryology, pathology, clinical findings and treatment have been discussed.

Acknowledgment: The authors wish to extend their appreciation to Miss Marie Kerwin,

medical librarian, for her assistance in obtaining material and references for this paper.

REFERENCES

1. Ladd, W. E. Duplications of the alimentary tract. *South. M. J.*, 30: 363, 1937.
2. Grove, E. W. and Porch, L. D. Duplication of the terminal ileum; report of a case. *South. M. J.*, 30: 735, 1943.
3. Phillips, K. T. Duplication cyst of the terminal ileum with acute inflammatory reaction; report of case. *Connecticut M. J.*, 10: 21, 1946.
4. Gross, R. E., Holcomb, G. W. and Farber, S. Duplications of the alimentary tract. *Pediatrics*, 9: 449, 1952.
5. Ladd, W. E. and Gross, R. E. Abdominal Surgery of Childhood, p. 83, Philadelphia, 1941. W. B. Saunders Co.
6. Hughes-Jones, W. E. A. Enterogenous cysts. *Brit. J. Surg.*, 22: 134, 1934.
7. Hudson, H. W. Giant diverticula or reduplications of the intestinal tract. *New England J. Med.*, 213: 1123, 1935.
8. Lewis, F. T. and Thyng, F. W. The regular occurrence of intestinal diverticula in embryos of the pig, rabbit and man. *Am. J. Anat.*, 7: 505, 1907.
9. Bremer, J. L. Diverticula and duplications of the intestinal tract. *Arch. Path.*, 38: 132, 1944.
10. Donovan, E. J. and Santulli, T. V. Duplications of the alimentary tract. *Ann. Surg.*, 126: 289, 1947.
11. LoPresti, J. M., Kaufman, P. and Hawfield, H. H. Duplication of the alimentary tract. *Clin. Proc. Child. Hosp.*, 6: 357, 1950.
12. Fleet, G. A. Misplaced gastrica mucosa as a cause of massive rectal hemorrhage. *Canad. M. A. J.*, 42: 216, 1940.

Progressive dilatations by the use of Hegar's metallic bougies are of some value in overcoming rectal stenosis due to lymphogranuloma venereum. However, these good effects are often only temporary, according to S. P. Orrego who supplements them with diathermy, hormonal therapy (estrogens) and, occasionally, a colostomy. The latter is usually performed on the transverse colon and later, after the stools become large enough, the colostomy can be closed. (*Richard A. Leonardo, M.D.*)

MANAGEMENT OF ACUTE GASTRODUODENAL PERFORATIONS*

EDWARD M. MILLER. M.D., WALTER L. MERSHEIMER, M.D. AND MARTIN E. SILVERSTEIN, M.D.

New York, New York

CHANGING concepts of the course of peptic ulcer disease together with advances in supportive therapy have stimulated continued interest in the management of acute gastroduodenal perforations. During the past decade three main trends in the therapy of this emergency have received attention: (1) simple suture of the perforation, (2) immediate subtotal gastrectomy or (3) non-operative treatment with antibiotics and continuous gastric suction. Each of these methods has its proponents who, in supporting their own particular therapeutic inclinations, have aroused a healthy and widespread concern with the whole problem. No one method of treatment should be considered ideal for all cases. Objective analysis of our own series as well as information obtained from the literature has led us to define some criteria that may assist the surgeon to individualize these patients.

In 1943 one of us (W. L. M.) reviewed eighty-nine cases of acute gastroduodenal perforations treated at the Metropolitan Hospital during 1930 to 1941, inclusive.[21] In the present study we are reporting a series of 106 acute gastroduodenal perforations treated at the same hospital during the following nine-year period (1942 to 1951), using the earlier series for comparison. By means of this comparative study we shall endeavor to evaluate the efficacy of our therapeutic methods and to appraise the influence of chemotherapy and antibiotics. It is also anticipated that certain concrete criteria may be derived which will delineate more clearly some indications for each of the three main types of treatment of acute gastroduodenal perforation.

History. There was a higher incidence of females in the present series. (Table 1.) In the earlier group there were eighty-four (96.5 per cent) males and three (3.5 per cent) females, whereas in the present series there were eighty-nine (84 per cent) males and seventeen (16 per cent) females. This proportion of females is quite high as compared with most reports[13,15,24,31,32,38] in which the average incidence is usually less than 10 per cent. However, in a recent review of the Roosevelt Hospital series Kingsbury and Peacock also noted a definite increase in the incidence of acute gastroduodenal perforations occurring in women.

The average age of incidence in the recent group was sixty years, which represents a fifteen-year increase over that reported in the earlier review. It is our impression that Metropolitan Hospital, a city institution caring for indigent and low income groups, has an older patient population than most endowed institutions; it may be that the apparent recent increase in the incidence of perforated ulcer in older age groups is a manifestation of a general increase in the average age of patients hospitalized in city institutions. The average age of incidence reported is generally between forty and fifty years. Our findings emphasize that perforated peptic ulcer is by no means a disease of young adults but also must be considered strongly when a patient from the middle or older age groups presents an acute abdominal problem.

In the recent series 84 per cent of the patients presented a history of previous symptoms suggestive of peptic ulcer disease, whereas in 16 per cent perforation was the first indication of the presence of the ulcer. The table shows that there has been a decided decrease in the proportion of patients without an ulcer history prior to perforation. It is interesting to note that all of the female patients gave a past history of epigastric distress whereas 18 per cent of the male patients had had no previous

* From the Surgical Service of The New York Medical College, Flower and Fifth Avenue Hospitals, and the Metropolitan Hospital, New York, N. Y.

suggestive symptoms. The average duration of ulcer symptoms was 6.5 years. However, of all patients with a past history suggestive of ulcer 38.1 per cent had had symptoms for one year or less, which would indicate that chronicity has no great effect on the tendency to perforate.

Of the series of 106 patients, seven (6.7 per cent) had survived a previous perforation. There was no history of previous perforation in any female patient in this series. Therefore the proportion of male patients with a second perforation was 7.9 per cent. These findings are in agreement with others in recent literature.[3,17,18]

A considerable proportion (19.4 per cent) of the patients experienced their first symptoms of perforation soon after ingestion of food or fluid. The onset of perforation occurred shortly after the intake of a heavy meal, alcoholic indiscretion, effervescent fluid in eighteen patients and a barium meal in one instance. Although the association of perforation with recent excessive alcohol consumption or "heavy meal" has been emphasized by others,[27,31,38] our findings support the contention that the perforation occurs most commonly when the stomach is empty.[38]

The prevalent impression that perforation is rarely accompanied by gastroduodenal bleeding is refuted by both the early and recent Metropolitan Hospital reviews. In the 1930 to 1941 series hematemesis or melena occurred in approximately 15 per cent of patients within twenty-four hours of the time of operation for perforation. In the recent series gastroduodenal bleeding was associated with perforation in twenty-nine cases (28.1 per cent); twenty of these presented with hematemesis. Moore stated that 20 per cent of the group studied at Bellevue Hospital had preoperative hemorrhage. In subjecting our series to further analysis it was found that hemorrhage occurred with the perforation in 50 per cent of the group of female patients; hematemesis was the manifestation of bleeding in the majority of these cases. On the other hand, concomitant hemorrhage and perforation was present only half as often in the male patients, occurring in 24.7 per cent.

Physical Examination. In spite of gross contamination of the peritoneal cavity with highly irritating fluids, clinical shock is associated with perforated peptic ulcer in less than 10 per cent of instances, according to most recent reports.[12,17,22,27,37] Shock was noted in 10 per cent in the early Metropolitan Hospital series, and in 15.1 per cent in the recent group. Patients who were admitted more than twelve hours after perforation constituted the majority of those cases with evidence of shock.

Absence or diminution of liver dullness on abdominal percussion is one of the classic indications of free air in the peritoneal cavity. This sign was elicited in 59.7 per cent of cases in the present series.

Another method of establishing the presence of air in the peritoneal cavity is by roentgenographic examination of the abdomen. This method yields positive evidence of pneumoperitoneum in 50 to 75 per cent of cases.[3,17,19,22,24,31] In the recent Metropolitan Hospital group free air was evident roentgenographically in 61.4 per cent, which represents an increase of 11 per cent over the previous series. (Table 1.) Nevertheless, it is obvious that a considerable proportion of perforated ulcers must be diagnosed in the absence of x-ray evidence of free peritoneal air.

The two Metropolitan Hospital series exhibited a remarkable constancy in the proportion of correct preoperative diagnoses as compared with the operative findings: 89.7 per cent in the 1930 to 1941 series and 89.8 per cent in the 1942 to 1951 series. Of the 10.2 per cent of cases of missed diagnosis, acute appendicitis was the most common incorrect diagnosis. Intestinal obstruction, acute cholecystitis and intussusception were suspected mistakenly in others. In two cases diagnosed simply as "bleeding ulcer" an associated perforation was unsuspected. In recent years peritoneal tap has been employed to good advantage to confirm the presence of diffuse peritoneal contamination.

F. W. Taylor describes a "hidden group" of cases of perforated peptic ulcer. These are instances which are apt to escape analysis since they are patients whose conditions were misdiagnosed or undiagnosed because of their moribund state. In our study there were nine such cases (8.5 per cent) in which the diagnosis was made only at autopsy. This proportion is similar to those reported by others.[27,34] Of the nine patients, five were comatose on admission, two were treated conservatively as having bleeding ulcers, another as acute intestinal obstruction, and the last as an uncomplicated peptic ulcer.

It is well recognized that the duration of time

between perforation and operation has a great influence on operative risk and mortality rate. For this reason it was of great concern to us to find that the average interval between perforation and admission to the hospital in the present series was approximately eleven hours, an

TABLE 1
ACUTE GASTRODUODENAL PERFORATIONS
(METROPOLITAN HOSPITAL)

	1930 to 1941	1942 to 1951
Total perforated peptic ulcers	87	106
Average age	45.1	60
Race: White	83	96
Colored	4	10
Sex: Male	84	89
Female	3	17
Previous ulcer history	72.4%	84%
No previous ulcer history	27.6%	16%
Associated hemorrhage	15.0%	28.1%
Perforated while in hospital	11.6%	5.7%
Shock	10.0%	15.1%
Diminished liver dullness	50.0%	59.7%
Pneumoperitoneum by roentgenography	50.0%	61.4%
Correct preoperative diagnosis	89.7%	89.8%
Diagnosed at postmortem examination	2.2%	8.5%
Duration between perforation and admission	8.48 hr.	10.8 hr.
Duration between perforation and operation	11.09 hr.	17.1 hr.
Site of perforation:		
Stomach	59.8%	49.5%
Duodenum	28.6%	43.0%
"Pyloroduodenal"	11.6%	7.5%
Operative mortality	25.2%	19.3%
Wound infection	31.0%	9.1%
Dehiscence and evisceration	11.6%	4.5%
Pneumonia	16.1%	4.6%
Atelectasis	6.9%	4.6%
No. of hospital days:		
Average	28	23
Shortest	12	10
Longest	93	89

increase of two hours over that reported in the former series. (Table 1.) Further analysis of this group reveals that whereas the average interval in the case of male patients was 9.3 hours, it was 24.7 hours in the group of female patients. The time elapsing between hospital admission and operation is a factor deserving of comment. In the present series there was an average delay of six hours before operation, whereas in the former series the average delay preceding operation was less than three hours.

Pathology. Although most reviews show a preponderance of duodenal over gastric perforations in a ratio of 3 or 4:1,[1,3,7,8,15,17,22,38] there are also large series[12,19,31] with a higher incidence of gastric perforations. In both Metropolitan Hospital series gastric perforations outnumbered duodenal perforations. There was a significantly greater proportion of gastric perforations among female patients (61.2 per cent as opposed to 47.2 per cent for males). An additional factor which may have had some bearing on the preponderance of gastric ulcers was the high proportion of elderly patients in this series.

Multiple gastroduodenal ulcers were noted in four cases (3.8 per cent). One female patient was found to have a perforated duodenal ulcer associated with a perforated ulcerating carcinoma of the greater curvature of the stomach. Another woman had two pyloric ulcers, one perforating and the other penetrating. One male patient had two gastric ulcers, one perforating and the second penetrating. The fourth patient, a male, had two perforated pyloric ulcers.

The possibility that a perforated gastric ulcer is malignant is of great significance. Simple closure of a malignant perforation by suture is inadequate treatment because complete or partial breakdown of the suture line commonly occurs and is associated with a high mortality rate. In the present series there were four instances of perforated malignant ulcer. This represents a proportion of 6.5 per cent of all ulcers which were not definitely located in the duodenum. More significantly, 18.2 per cent of the gastric ulcers in women were malignant while only 4 per cent of those in men were found to be carcinomatous.

Cultures of peritoneal fluid taken at operation do not yield pathogenic organisms in the great majority of instances.[13,17,22,30,38] The peritoneal fluid was submitted for culture in forty-two of the eighty-eight operative cases studied in the 1942 to 1951 series. In twenty-six cases (61.9 per cent) there was no bacterial growth. In those cases in which operation was performed twelve hours or less after perforation, cultures were negative in 76 per cent. Positive cultures yielded growth of Staphylococcus aureus in seven instances, Bacillus coli in five, Streptococcus viridans in three, Streptococcus hemolyticus in one and Aerobacter aerogenes in one.

Treatment. Of the 106 patients in the recent series, eighty-eight underwent surgical procedures. There were nine patients who were treated by a conservative regimen, which included continuous gastric suction, maintenance of fluid and electrolyte balance and administration of chemotherapeutic or antibiotic agents. The nine cases in which the diagnosis was made at autopsy have been described previously. In the surgical group simple suture of the perforation with or without omental graft was employed in eighty-six cases, simple suture and gastrojejunostomy in one instance and subtotal gastric resection in one case.

Excluding the nine cases in the "hidden group," there were seventeen deaths, representing an over-all mortality of 17.5 per cent. Twelve deaths occurred among the male patients, a mortality rate of 14.3 per cent, and five deaths among the female patients, a mortality rate of 38.5 per cent. The operative mortality of the recent series was 19.3 per cent, representing an improvement of approximately 6 per cent over the earlier series. The mortality rate was considerably higher in the female group (41.7 per cent) than in the male group (15.8 per cent). In the group undergoing simple suture alone the mortality rate was 18.6 per cent.

The causes of death following operative intervention were: congestive heart failure in four cases, generalized peritonitis in four cases, pulmonary embolus in three cases, massive hematemesis and shock in three cases, and in the three remaining instances intestinal obstruction, hydropneumothorax and carcinoma of the esophagus with bilateral massive atelectasis, respectively. It should be noted that all four patients who died of generalized peritonitis underwent operation in 1942 and 1943 before the general use of antibiotics. In three of these cases the only chemotherapeutic agent employed was intraperitoneal sulfanilamide, and in the fourth, intraperitoneal sulfanilimide was followed by intravenous sulfadiazine.

Of those patients who died postoperatively, 55.6 per cent were over sixty years of age. Again in this group, the average duration of time between perforation and operation was twenty-four hours. However, in a group of twenty-two patients who underwent operation six hours or less after perforation there were only two deaths, constituting a mortality rate of 9.1 per cent. Of the thirty-two patients operated upon between six and twelve hours of the time of perforation, there were six deaths, representing a mortality of 18.8 per cent. These findings are comparable to those reported in the recent Bellevue Hospital series.[24]

No deaths occurred in the highly selected small group of nine patients treated with a non-operative conservative regimen. Operation was not performed on these patients because they presented a clinical picture either of late perforation which appeared to be "walling off" or severe constitutional disease which rendered them poor operative risks.

As previously noted, gastroduodenal hemorrhage was associated with perforation in twenty-nine patients (28.1 per cent) in the recent series. The adverse effect of associated hemorrhage upon the prognosis is manifest in the finding that 31 per cent of the group with this complication died during the immediate postoperative period. Twenty-one patients were treated by simple suture and six (26.1 per cent) continued to bleed postoperatively; there was a hospital mortality of 33.3 per cent in this group. In two additional patients who bled after plication, gastric resection was employed successfully to control the hemorrhage. Of five patients with hemorrhage and perforation treated with non-operative measures, three continued to bleed. One of these patients underwent gastrectomy with recovery and the other two died, representing a mortality of 40 per cent. In the remaining case the true nature of the lesion was discovered only at postmortem examination. It is evident that when hemorrhage and perforation occur concomitantly the mortality rate rises sharply. Our results indicate that simple suture is not an effective method for managing this problem.

Complications. Routine administration of antibiotics appears to be one of the most important factors in reducing postoperative complications. Wound infection, which occurred in 31 per cent of cases in the early Metropolitan Hospital series, decreased to 9.1 per cent. Only four patients (4.6 per cent) of the recent series had postoperative pneumonia, whereas this complication was noted in 16.1 per cent of the previous series. Three of these four patients with pneumonia were treated in 1942–1943 before the introduction of antibiotic therapy. Atelectasis was observed in four cases (4.6 per cent), exhibiting no marked change in incidence

compared with those reported in the current literature.[17,18,38]

Postoperative wound disruption with or without evisceration occurred less frequently (4.5 per cent) in the present series, and the lowered incidence in our opinion can be explained by the more frequent use of the Amendola incision.

Intra-abdominal abscess occurred as a postoperative complication in 2 per cent of cases (one subphrenic and one pelvic abscess). However, after the non-operative treatment, intra-abdominal abscess developed in five of nine patients so treated, an incidence of 55.6 per cent (two subphrenic and three subhepatic abscesses). F. W. Taylor, also, has found that subphrenic abscess occurs more frequently among patients treated conservatively. Etiologically, one must suspect that the increased incidence has as its basis an incompletely sealed perforation with continued local leakage. The higher incidence of serious complications offers a cogent argument against universal employment of conservative therapy for all acute gastroduodenal perforations.

COMMENTS

Simple suture of an acute gastroduodenal perforation has been the time-honored treatment of choice among most surgeons. The outstanding proponent of the method was Roscoe Graham who considered it an effective emergency procedure designed primarily to save a life rather than to cure the ulcer. In simple closure of the perforation the surgeon has a quick and definitive means of terminating peritoneal contamination. As a life-saving measure, plication of the perforated ulcer (usually accompanied by a re-inforcing omental graft) results in a mortality rate of less than 10 per cent when the operation is performed within twelve hours after perforation has occurred.[3,7,13,20,29]

The mortality rate is affected by many factors among which should be considered the sex of the patient, age of the patient, location of the perforated ulcer, time interval between perforation and operation, and the presence or absence of hemorrhage. The mortality among our female patients was more than twice that occurring among male patients, conforming with other recent reports.[11,20,22] McElhinney believes that the high mortality among women is due to late diagnosis and treatment; this contention is substantiated in the Metropolitan Hospital series in which the interval between perforation and operation was almost twice as long among the female patients as among the males.

It is generally agreed that the mortality rate in patients with perforated ulcer increases with the age of the patient. Black reported mortality rates of 4 per cent in patients less than forty years of age, 12 per cent in those between forty and fifty, and 18 per cent in those over fifty. Since the average age of the patients in the recent Metropolitan Hospital series was over sixty years, the operative mortality rate of 19.3 per cent does not seem inordinately high. We are in agreement with Niemeier who states, "We must be prepared to diagnose perforation in the aged in the presence of less marked signs and symptoms than in other individuals."[25]

Gastric perforation carries a much graver prognosis than does duodenal perforation.[11,20] The mortality rates in Forty's study agree closely with those in the Metropolitan Hospital series: 42 per cent for gastric perforations, 15.5 per cent for juxtapyloric perforations and 10 per cent for duodenal perforations. Jones maintains that there has been a recent uniform diminution of mortality rates in cases of perforated duodenal ulcer while the prognosis of gastric perforations has remained relatively unchanged. The higher proportion of gastric perforations in women together with their longer delay in seeking treatment probably explains the higher mortality rate in the female group.

Delay in treatment has a direct influence on the immediate mortality. In the recent Metropolitan Hospital series the mortality rate doubled during the second six hours and almost tripled during the third six hours. The foregoing proportions are similar to those reported by Niemeier. Therefore delay in diagnosis and therapy tends to nullify the advantages accruing from antibiotic therapy and fluid and electrolyte replacement.

A striking disclosure noted in both Metropolitan Hospital studies was the high incidence of gastroduodenal hemorrhage associated with perforation. Nearly one-third of the patients in the 1942 to 1951 series entered the hospital with hemorrhage as well as perforation. Of greater significance was the fact that 31 per

cent of the patients with this complicating feature died during the immediate postoperative period. Simple plication failed to control bleeding in 26 per cent of the cases in which it was employed. Hemorrhage may arise from a so-called "kissing ulcer," i.e., a posterior penetrating duodenal ulcer associated with a perforating ulcer of the anterior aspect of the duodenum.[6] A perforating gastric ulcer may erode a branch of the left gastric artery causing massive bleeding. In our opinion, simple suture is incomplete emergency treatment when such complicating situations occur.

Non-operative therapy has been reserved usually for the treatment of patients in whom perforation has been present for more than twenty-four hours. Recently there has been a number of reports describing the advantages of non-operative treatment not only in these late cases but also with recent perforations.[4,5,30,34,35,39] The conservative regimen includes: cessation of oral intake, continuous gastric suction, parenteral alimentation and administration of antibiotics. Employing this method, F. W. Taylor has reported a mortality rate of 8.3 per cent in twenty-four cases, and Seeley has treated thirty-four consecutive unselected patients without a fatality. Those who favor the conservative method maintain that operation may be not only superfluous but also harmful in a patient who shows signs of having spontaneous sealing of an early perforation.[34,39] With the non-operative method, wound infection, evisceration and incisional hernia are averted.[30] When the diagnosis is in doubt, conservative therapy is advantageous since a non-surgical lesion may be present (myocardial infarction, pneumonia or pleurisy[5]) and in such instances surgical intervention would be distinctly harmful. Those[27,29,36] not satisfied with the results of conservative therapy for recent perforations contend that "most perforated ulcers are chronic, with thick, rigid walls and surrounding tissues, and they tend to remain patent unless sutured or blocked by omentum."[29] Furthermore, gastric suction does not adequately control leakage,[29] the diagnosis may be in error[36] and subdiaphragmatic abscess occurs more frequently.[34] As a result of the high incidence of intra-abdominal abscess (55.6 per cent) in the cases treated conservatively in our series, we have been reluctant to employ the method more frequently.

For many years subtotal gastrectomy has been successfully employed by surgeons on the European continent for selected cases of perforated gastroduodenal ulcer. In Yudin's series of 937 partial gastric resections for selected cases of perforated ulcer there was a mortality rate of 8.9 per cent as compared with 31.7 per cent in 435 simple plications. Only those patients under forty-five years of age underwent gastrectomy. More recently, Ferreira reported a mortality rate of 7.7 per cent in twenty-six cases of subtotal gastric resection, Nuboer a mortality of 1.6 per cent in sixty-two cases, and Banzet has performed thirty-five consecutive partial gastric resections for acute gastroduodenal perforations with no deaths. One reason advanced for urging that partial gastrectomy be performed more frequently is that resection offers the patient an excellent chance for cure of his disease.[33] At least 60 per cent of patients who have been treated by simple suture for perforated ulcer continue to have symptoms referable to the ulcer, and at least 33 per cent of the total ultimately require additional surgical intervention.[7,14,15,23,24,28,40] F. D. Moore states that "a perforation . . . if followed by even a single relapse denotes a virulent form of the disease and unless dealt with by definitive surgery bodes ill for the prognosis of the patient." The advocates of partial gastrectomy emphasize the difficulty in distinguishing a benign from a malignant gastric ulcer grossly or even by microscopic examination of a limited biopsy, and stress the hazard of leakage from a sutured perforation through carcinomatous tissue.[6,9] When gross hemorrhage and perforation occur concomitantly, subtotal gastrectomy is preferable to simple suture since it effectively deals with the source of the bleeding. Additional indications suggested for which subtotal gastric resection is indicated when perforation is present are: coexisting fixed pyloric obstruction,[6] recurrent perforations indicating a "virulent ulcer diathesis"[6] and perforations in patients with a long ulcer history since the perforation usually has thick fibrous edges which render effective suturing extremely difficult.[2] The infrequent occurrence of shock and of positive peritoneal cultures in early cases (as evidenced by our own series as well as reports in the literature) and the effectiveness of antibiotic therapy further support the view that partial gastrectomy may be performed in good risk patients with a

mortality approaching that of the elective operation.

CONCLUSIONS

An evaluation of the data derived from our study suggests the following conclusions:

1. Perforated gastroduodenal ulcer is occurring in older patients and in women with increasing frequency. It is important to realize that the symptoms and signs may be less definite in these groups of cases. However, a higher index of suspicion should being these patients to surgery earlier and should result in a reduction of the present high mortality rate.

2. The therapy of perforated peptic ulcer should be rational and highly individualized. To decree that a particular method should be employed in all cases is an oversimplification of fact. The pathologic vagaries of the human organism are the result of manifold obscure forces and no one therapeutic method will apply to all cases. The choice of treatment must be governed by a careful appraisal of the individual problem at hand, weighing the several factors and realizing that the method selected has proved effective in a similar set of circumstances.

3. Simple plication remains the method of choice in most instances, particularly when perforation is the first indication of ulcer disease or when the history is of short duration. The older patient is most safely treated by simple plication.

4. Immediate partial gastrectomy is indicated when spontaneous gastroduodenal hemorrhage and perforation coexist and is the treatment of choice when the perforation occurs through a malignant lesion. Immediate gastric resection should be considered seriously when there is a perforated gastric ulcer in a female patient. Additional indications which require evaluation are: when perforation occurs in a patient with a long history of duodenal ulcer disease, when there is recurrent perforation and when perforation and pyloric obstruction are both present. It is preferable that the following criteria are met before proceeding with subtotal gastric resection: (1) patient in good constitutional condition and less than fifty years of age; (2) perforation of less than twelve hours' duration; (3) no sign of clinical shock; (4) no evidence of extensive peritonitis; and (5) operative and anesthetic facilities comparable with those available for an elective gastrectomy.

5. Conservative treatment is best employed (1) when the perforation has been present for more than twenty-four hours; (2) in the presence of severe shock; or (3) in the presence of severe or uncontrolled constitutional disease.

REFERENCES

1. Avent, C. H., Patterson, R. H. and Chambers, J. M. Acute perforated gastroduodenal ulcer. *South. Surgeon*, 13: 613–621, 1947.
2. Banzet, P. Immediate gastrectomies in acute perforations. *Postgrad. Med.*, 7: 391–396, 1950.
3. Baritell, A. L. M. Perforated gastroduodenal ulcer. *Surgery*, 21: 24–33, 1947.
4. Bedford-Turner, E. W. Conservative treatment of duodenal ulcer. *Brit. M. J.*, 1: 457, 1945.
5. Bingham, D. L. C. The treatment of acute perforated peptic ulcer. *Canad. M. A. J.*, 58: 1–5, 1948.
6. Bisgard, J. D. Gastric resection for certain acute perforated lesions of stomach and duodenum with diffuse soiling of the peritoneal cavity. *Surgery*, 17: 498–509, 1945.
7. Black, B. M. and Blackford, R. E. Perforated peptic ulcer: review of 96 cases. *S. Clin. North America*, 25: 918–928, 1945.
8. Collins, D. C. An eleven year review of perforated peptic ulcers at the Hollywood Presbyterian Hospital. *Ann. West. Med. & Surg.*, 1: 282–288, 1947.
9. Doll, R. Perforated carcinoma of the stomach simulating perforated gastric ulcer. *Brit. M. J.*, 1: 215–218, 1950.
10. Ferreira, A. E. M. Primary gastrectomy for perforated peptic ulcer. *Postgrad. Med.*, 7: 330–338, 1950.
11. Forty, E. One hundred cases of perforated peptic ulcer: with an analysis of immediate and remote results of simple closure. *Brit. M. J.*, 1: 790–793, 1946.
12. German, R. M., Jr. and Tieche, A. U. Acute perforation of gastroduodenal ulcer: report of forty-two cases. *West Virginia M. J.*, 45: 208–211, 1949.
13. Graham, R. R. and Tovee, E. B. The treatment of perforated duodenal ulcers. *Surgery*, 17: 704–712, 1945.
14. Houston, W. The aftermath of perforated peptic ulcer. *Brit. M. J.*, 2: 221–223, 1946.
15. Illingworth, C. F. W., Scott, L. D. W. and Jamieson, R. A. Progress after perforated peptic ulcer. *Brit. M. J.*, 1: 787–790, 1946.
16. Jones, F. A., Parsons, P. J. and White, B. Acute perforated peptic ulcer: a study of the recent fall in mortality. *Brit. M. J.*, 1: 211–215, 1950.
17. Kingsbury, H. A. and Peacock, E. E. Acute perforation of peptic ulcer: early and late results. *Surg., Gynec. & Obst.*, 92: 717–720, 1951.
18. MacKinnon, D. C. Acute perforated gastric and duodenal ulcer. *Minnesota Med.*, 30: 1253–1262, 1947.
19. Mage, S. and Payson, B. A. A consideration of the present status of simple suture in the treatment of acute perforated gastroduodenal ulceration. *Surg., Gynec. & Obst.*, 94: 581–590, 1952.

20. Mayo, H. W. and Fitchett, C. Immediate and late results of the surgical therapy of acute perforated gastric and duodenal ulcer. *Surgery*, 28: 82–89, 1950.
21. McCabe, E. J. and Mersheimer, W. L. Acute gastroduodenal perforations. *Am. J. Surg.*, 62: 39–49, 1943.
22. McElhinney, W. T. and Holzer, C. E., Jr. Factors influencing mortality from acute perforated peptic ulcers. *Surg., Gynec. & Obst.*, 87: 85–92, 1948.
23. Moore, F. D., Peete, W. P. J., Richardson, J. E., Erskine, J. M., Brooks, J. R. and Rogers, H. The effect of definitive surgery on duodenal ulcer disease: a comparative study of surgical and non-surgical management of 997 cases. *Ann. Surg.*, 132: 652–680, 1950.
24. Moore, S. W. Acute perforation of peptic ulcer. *S. Clin. North America*, 30: 429–441, 1950.
25. Niemeier, O. W. Improved results in perforated peptic ulcer. *Canad. M. A. J.*, 61: 250–254, 1949.
26. Nuboer, J. F. Primary partial gastrectomy for perforated ulcer. *Lancet*, 261: 952–954, 1951.
27. Olson, H. B. and Norgore, M. Perforated gastroduodenal ulcers: a study of 166 cases. *Ann. Surg.*, 124: 479–491, 1946.
28. Parker, E. F. The late results in acute perforated peptic ulcer treated by simple suture: with particular reference to multiple ulcer. *Surgery*, 10: 49–63, 1941.
29. Rose, T. F. Perforated peptic ulcer: the mortality and morbidity of treatment. *M. J. Australia*, 1: 421–425, 1950.
30. Seeley, S. F., Hogan, E., Henry, J. R. and Bertram, H. F. Non-operative treatment of perforated duodenal ulcer. *Bull. U. S. Army M. Dept.*, 9: 124–130, 1949.
31. Shipley, E. R., and Walker, J. H. Perforated gastric and duodenal ulcers. *Am. J. Surg.*, 77: 329–337, 1949.
32. Strang, C. and Spencer, I. O. B. Factors associated with perforation in peptic ulcer. *Brit. M. J.*, 1: 873–876, 1950.
33. Strauss, A. Primary gastric resection for perforated gastroduodenal ulcers. *Ann. Surg.*, 120: 60–65, 1944.
34. Taylor, F. W. and Egbert, H. L. Non-operative treatment of perforated peptic ulcer. *Surg., Gynec. & Obst.*, 94: 464–468, 1952.
35. Taylor, H. Perforated peptic ulcer: treated without operation. *Lancet*, 2: 441–444, 1946.
36. Truscott, B. McN. and Withycombe, J. F. R. Perforated peptic ulcer: an assessment of the value of non-operative treatment. *Lancet*, 1: 894–896, 1950.
37. Tullis, R. H. Perforated gastroduodenal ulcer. *Am. J. Surg.*, 78: 490–495, 1949.
38. Turner, F. P. Acute perforations of stomach, duodenum, and jejunum: an analysis of 224 cases with late follow-up data on 147 cases of acute perforated peptic ulcer. *Surg., Gynec. & Obst.*, 92: 281–295, 1951.
39. Visick, A. H. Conservative treatment of acute perforated peptic ulcer. *Brit. M. J.*, 2: 941–944, 1946.
40. Werbel, E. W., Kozoll, D. D. and Meyer, K. A. Surgical sequelae following recovery from a perforated peptic ulcer. *S. Clin. North America*, 27: 93–108, 1947.
41. Yudin, S. S. Partial gastrectomy in acute perforated peptic ulcer. *Surg., Gynec. & Obst.*, 64: 63–68, 1937.

LEIOMYOSARCOMA OF THE STOMACH*

REVIEW OF THE LITERATURE AND A REPORT OF SEVEN CASES

CHARLES L. POSKANZER, M.D. AND RUDOLPH M. SCHMIDT, M.D.

Albany, New York

ALTHOUGH leiomyosarcoma of the stomach is relatively rare, the fact that several cases have come to our attention in the past few years prompted the study of the subject. The purpose of this paper is to report these cases, review the pertinent literature, find out the important diagnostic features and emphasize the good prognosis following surgical extirpation of these tumors, even the large ones, provided metastases are absent. The early diagnosis and prompt treatment of leiomyosarcoma of the stomach deserve special consideration because the prognosis is much better than that of carcinoma in a comparable stage of development. The differentiation between this form of sarcoma and other types is important in determining the therapeutic approach.

In 1938 Chaffin[1] made an extensive review of the literature and found 363 cases of smooth muscle tumors of the stomach, of which 77 per cent were considered benign. In the cases reported the term myosarcoma was used extensively. The term leiomyosarcoma has supplanted myosarcoma, both of which are considered to be malignant. Thus of the 363 cases of smooth muscle tumor, 23 per cent were malignant.

In 1948 Marvin and Walters[2] reported sixteen cases of leiomyosarcoma (one of which was multiple) seen at the Mayo Clinic. The authors give three cardinal symptoms which must be recognized as most satisfactory, namely, gastrointestinal hemorrhage, epigastric distress and ulcer-like symptoms, and palpable tumor. Zellhoefer[3] says, "Suspect sarcoma in a young person who has bleeding from the stomach and a large gastric tumor without pyloric obstruction."

Marshall and Meissner[4] as recently as 1950 reported nine cases, with survival five years or more following operation.

Most of the literature records only single or short series of cases. Seven cases of this type will be presented in this article.

The incidence of these tumors varies greatly, according to the various reported statistics. Lemon and Broders[5] report they form 1 per cent of all gastric neoplasms; in others they form up to 8 per cent. More recently it has been estimated that leiomyosarcoma of the stomach occurs once in 1,000 cases of gastric carcinoma.

The tumor appears to be distributed approximately equally between the sexes; but if there is a predominance in any given series, it is invariably in favor of the male sex. The age incidence likewise varies greatly, since the tumor has been described in patients as young as seven years of age and in patients as old as ninety. A majority of the cases occur between the fourth and seventh decades. Lemon and Broders[5] report that the age is usually from forty to sixty years, with an over-all range of from three to ninety-one years.

It would seem almost of doubtful value to discuss the etiology of leiomyosarcoma of the stomach. Some investigators have had suggestions concerning the causation of the neoplasm. Chaffin,[1] for instance, suggests that it may be due to the unchecked proliferation of smooth muscle during the healing of chronic ulcer since peptic ulcers often accompany the lesion. It has also been suggested that benign myomas of the stomach may undergo malignant changes and develop into leiomyosarcomas. France and Brines[6] take this view, as does Herbut.[7] Zellhoefer[3] presented a case which at first was a benign leiomyoma and which had undergone malignant ulceration.

Yardumian[8] reported two cases in which there were areas resembling benign myomas and also sarcomatous areas. Hypertrophy of the pyloric smooth muscle has been found in some cases of pernicious anemia, which raises

* From the Department of Pathology, Albany Hospital and Albany Medical College, and the Laboratory of the Ellis Hospital, Schenectady, N. Y.

the question as to whether or not certain blood dyscrasias may play an etiologic role. Indeed, one of the cases in our series had a previous diagnosis of pernicious anemia. It is probable, however, that the anemia was an incidental diagnosis and played no part in the development of a leiomyosarcoma. Embryonal rests, after the theory of Cohnheim, have also been suggested.

The usual location of these neoplasms of the stomach is a matter on which there is no general agreement. Chaffin[1] reports that these malignant tumors occur in the lower portion of the stomach with the highest incident per unit per area at the pylorus and the next highest incidence in the cardia. Lemon and Broders,[5] on the other hand, report that the tumors rarely occur at or near the orifices of the stomach and are usually in the antrum, although rarely at the pylorus and never at the cardia. It would appear, therefore, that the location of these varies considerably and is actually more of academic than practical significance.

From a pathologic standpoint, leiomyosarcomas of the stomach are interesting. They are mesenchymal tumors. They arise in general from smooth muscle cells of the gastric wall. According to Holta[9] they are found endogastrically, intramurally or exogastrically. The endogastric forms develop submucosally. The mucous membrane usually remains intact for a long time until it becomes necrotic and ulcerates. These tumors are often pedunculated and are attached by a broad base. The intramural forms are usually diffuse thickenings in the muscularis. The exogastric forms are usually the largest.[10]

The directional growth determines, in large measure, symptoms produced by the tumor. Because they arise from the more vascular framework of the gastric wall, they tend to be more vascular than carcinomas. Their size varies with the rate of growth and the duration of the tumor. Often the larger tumors may erode the overlying gastric mucosa, frequently leading to bleeding, thus accounting for those cases in which massive hemorrhage occurs.

Microscopic examination of these tumors shows them to be composed of great masses of smooth muscle cells, usually well differentiated and well formed, with rod-shaped and elongated nuclei, occasionally mitotic figures. Generally the cells are long and spindle-shaped, and form interlacing bundles similar to those found in the smooth muscle tumors of the uterus. Occasionally there is a tendency toward cytoplasmic vacuolization. In the more rapidly growing tumors, which are generally rarer, the neoplastic cells appear more atypical, lose their tendency to differentiate into spindle-shaped cells and often form atypical cells of unusual and abnormal shapes. Mitotic figures are generally much more numerous. Like other large tumors, leiomyosarcomas are subject to secondary degenerative changes such as mucoid degeneration, infarction and necrosis, and not infrequently the neoplasms may appear edematous and contain foci of hemorrhage.[11]

As a rule leiomyosarcoma of the stomach has a tendency to metastasize late, but like other forms of gastric sarcoma, about one-half of the tumors do metastasize. The primary site of metastasis is usually to the regional lymph nodes in the neighborhood of the stomach although not uncommonly secondary growths are also found in the liver. Occasionally they are found elsewhere. Prognosis, as in the case of other tumors where metastases are present, is worse after metastases have formed, but in one case known liver metastasis was present in the patient who survived at least six years.

The clinical symptoms produced by gastric leiomyosarcoma are variable but are, unfortunately, remarkably like those produced by gastric ulcer and other types of gastric tumors. Occasionally however, according to some observers, the history may be suggestive of leiomyosarcoma rather than carcinoma or ulcer because of lack of pain and the presence of an easily palpable mass. In many cases symptoms do not appear until late, especially if the tumor is exogastric. For this reason a thorough knowledge of the many and varied symptoms which leiomyosarcoma may produce is essential if symptomatology is to aid in making a correct diagnosis.

The symptoms, as noted heretofore, are very varied. They may be present, according to Chaffin,[1] for as brief a period as a few days or for as long as forty years. However, in half the cases duration was two years or less. The most important symptoms in Chaffin's experience were the following: palpable mass in the epigastrium in 90 per cent of the cases; hematemesis, melena or anemia alone 80 per cent,

in combination 77 per cent; indigestion 46 per cent; and vomiting 44 per cent.

On the other hand, Lemon and Broders,[5] in a study of fourteen cases of gastric sarcoma of which eleven were leiomyosarcoma, found that gastric symptoms of some kind were present for an average of three and a half years, with extremes of four months and fifteen years. An abdominal mass, abdominal pain, hemorrhage or loss of weight were the symptoms which most often caused the patient to consult his physician. Of these, pain was the most common; nausea and vomiting were second in order of frequency although hematemesis occurred only infrequently. Third in order of frequency was abdominal mass. Fever was sometimes present, apparently chiefly due to secondary infection. Dizziness and fainting were occasionally reported, usually preceding hematemesis. The symptoms as noted in these two series of cases appear to be generally the same but the frequency of each varies somewhat.

Although the symptoms of nausea, vomiting and abdominal pain with the presence of an abdominal mass represent the usual important clinical findings,[2,3] the onset may sometimes be marked by sudden massive gastric hemorrhage without any previous symptoms or signs.[12] In other cases the only finding is intractable secondary anemia of unknown etiology. In one unusual case the first symptom was a cough productive of grayish sputum, accompanied by pain in the left hemithorax, and a 40 pound weight loss. The patient died; postmortem examination revealed leiomyosarcoma of the stomach with multiple metastases to lungs, heart, ribs and several other sites in the body.[13]

Since many of the symptoms of this lesion are commonly associated with other complaints, the onset of those relative to the tumor is difficult to establish.

In our series the complaints had been present for varied periods. One patient (Case I) had had indigestion all his life, tarry stools seven weeks before admission and hematemesis two weeks before admission. Another patient (Case III) had had epigastric pain and vomiting for two years. Three months of epigastric pain preceded the admission of another individual (Case VI). Four of the seven patients reported nausea and vomiting, and three had hematemesis. Pain was prominent in two individuals. Although only two had evidence of tarry stools, definite anemia was present in six. Most patients showed a progressive weight loss but the exact information on this is lacking.

LABORATORY AND ROENTGENOLOGIC DATA

Laboratory data of themselves are never of specific diagnostic aid in this form of sarcoma since other gastric lesions may present similar symptoms.[14] One of the most common findings is secondary anemia whose etiology is often unexplained until the gastric lesion is demonstrated. Bloody stools, although frequent, are not a constant finding. In many cases the gastric acidity is reduced but some free hydrochloric acid is nearly always present. However, Chaffin[1] states that there is no correlation between the presence of anacidity or hyperacidity and the findings at pathologic examination. In a report of four cases three patients showed a reduced amount of hydrochloric acid on gastric analysis and only one showed no free hydrochloric acid. Of three patients in our series who had gastric analysis, only one had free acid in the fasting specimen but all had free acid in later samples. The total hydrochloric acid was somewhat reduced compared to normal values.

Roentgenologic findings are not conclusive but may sometimes suggest the diagnosis. Filling defects may be noted but these are difficult to distinguish from other neoplasms or a rare benign tumor. If the tumor is small or exogastric, there may be no roentgenologic indication of its presence. When the tumor becomes large, there is lateral displacement of the stomach and the lumen becomes narrowed as the wall thickens. The sarcomas, in contrast to the carcinomas, frequently tend to break down and degenerate in their interior allowing barium to trickle into the mass, as seen in Figure 8. Two such cases with tumor cavity communicating with gastric lumen were recently reported.[17]

In a short series of cases reported by Bassler[14] x-ray showed general stiffening of the gastric wall and some serrations were noted. Pyloric obstruction may occur. In recent years the accuracy of this method of examination has increased with use of varying densities of barium mixtures, and more cases will probably be detected in the future. Palpation of the partially filled stomach under the fluoroscope

may reveal filling defects which might otherwise be missed.

In addition, gastroscopic biopsies will facilitate diagnosis and gastroscopy itself may be of some help. Some authors[15,16] report that they can identify submucosal tumors, and in reviewing a series of four cases believe the diagnosis could have been made in three. They base this opinion on the convergence of the gastric folds toward the upper end of the wall and an intact mucosa over the lesion. Although they admit difficulty in differentiating it from lymphosarcoma, translucency of the mucosa over tumorous regions is an important sign.

No other laboratory data are usually found which can be explained on the basis of the primary lesion, but occasionally metastasis in other organs gives rise to findings which may serve to confuse the diagnosis of the original lesion.

DIFFERENTIAL DIAGNOSIS

Although other lesions of the stomach induce symptoms similar to those of leiomyosarcoma, very often there are some points of differentiation which may facilitate the diagnosis. The conditions to be considered in the differential diagnosis and some of the differential points are as follows: (1) *Lymphosarcoma:* This tumor frequently involves the pylorus and usually occurs in a slightly younger age group (thirty to forty years). It is probably radiosensitive and lymphatic tissue elsewhere in the body is likely to be involved. (2) *Carcinoma:* This neoplasm occurs mostly in the age group around sixty years. It first involves the mucosa. Ulceration, hemorrhage, infection and perforation occur earlier, and it also metastasizes earlier. Anemia, emaciation and cachexia are prominent. If an abdominal mass appears, it is usually late; and then the mass is fixed, not movable. Anacidity is more common, especially in the late cases. (3) *Peptic ulcer:* This can often be differentiated by a typical ulcer history, relief from pain by food, absence of a mass, point tenderness and hyperchlorhydria. X-ray analysis may be helpful but the presence of an ulcer does not rule out malignancy. (4) *Leiomyoma:* This can be differentiated only by biopsy at operation or autopsy. (5) *Polyps:* These are very often multiple. Exact diagnosis depends upon examination at operation or autopsy. (6) *Gastric syphilis:* Wassermann test and a history of luetic infection are an indication but not conclusive. (7) *Tumors and cysts of abdominal viscera:* These are often difficult to diagnose except at operation. (8) *Banti's disease with gastric hemorrhage and anemia:* In this the spleen and liver are usually palpably enlarged.

TREATMENT AND PROGNOSIS

Leiomyosarcoma is one of the more common varieties of sarcoma of the stomach which come to the attention of the surgeon. Intramural at first, it frequently attains an enormous size. The polypoid myomas are usually on the interior of the stomach; the large myosarcomas are more commonly exogastric. They grow under the serosa and become pedunculated because of their great size and weight. These huge tumors, originating from the greater curvature of the stomach, spread between the layers of omentum and so may give a false impression of inoperability when first examined by the surgeon.

The procedure of choice is subtotal gastric resection except in the case of a single pedunculated tumor which can be excised together with the adjacent stomach wall.

Radiation therapy has no place in the treatment of this tumor according to Pack and McNeer.[10] These authors report four cases in which partial gastric resection was performed, resulting in one operative death. In the other three patients there was a survival period of at least twelve, two and a half, and one and a half years, respectively. One patient with a similar lesion died four months following radiation therapy without operation. In two other cases in which treatment was by radiation, one with metastasis showed no effect and the other showed some shrinkage of the mass after therapy but died.

So few cases have been reported in the literature on the prognosis of leiomyosarcomas of the stomach that it is difficult to state the prognosis in any given case. However, from the evidence at hand, removal of the tumor before it is far advanced gives a much better prognosis than gastric carcinoma at a similar stage of development. The reasons for this are mainly two: First, the manner in which it grows, i.e., it does not tend to infiltrate and may show some semblance of a capsule or delineation from adjacent normal tissue. Second, when it does metastasize it does so late in its development. In one series of cases the average duration of

follow-up was four years. One of the cases recorded in this paper shows a five-year period in which tumor was known to be present although it was originally classified as a myoma. If the tumor is discovered late and removal is done as a palliative procedure, the prognosis is, of course, much less favorable. The prognosis varies with each case and depends primarily on the extent of advancement of the lesion when it is discovered. Since the tumors grow so slowly, excision should be attempted whenever the diagnosis is made. This is the treatment of choice except in those instances in which the condition of the patient prohibits surgical intervention or in the presence of metastasis.

CASE REPORTS

CASE I. R. W. E., a thirty year old white man, entered the hospital with an "ulcer of the stomach." The patient complained of having had indigestion all his life, gaseous eructations and feelings of epigastric fullness. There had been weakness, tiredness, occasional nausea and vomiting. The last vomitus occurred two weeks prior to admission, with hematemesis. Tarry stools were noticed seven weeks before admission and occasionally since then. Past history was negative except for hemorrhoidectomy six months prior to admission. Family history revealed that the patient's mother died of "stomach trouble" at the age of sixty-two.

Physical examination revealed marked tenderness but no masses palpable in the epigastric region; there were no abnormal findings. Blood pressure was 98/60. Blood picture showed hypochromic anemia. Repeated stool examinations were positive for occult blood. Gastrointestinal roentgenograms showed an outpocketing filling defect suggesting ulcer of the lesser curvature.

As a result of these findings operation was decided upon and partial gastrectomy with posterior gastrojejunostomy was performed. The patient recovered uneventfully and was discharged on the eighteenth postoperative day.

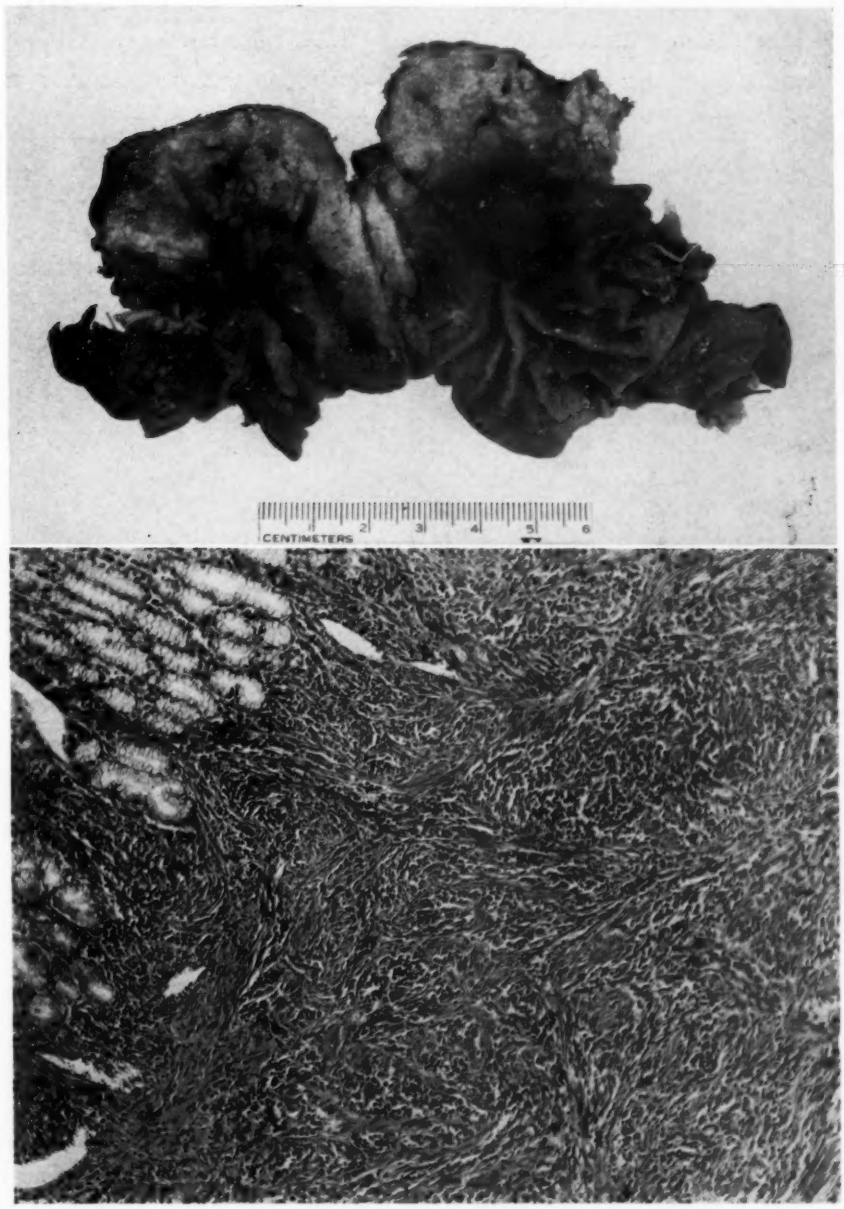
Pathologic report (Figs. 1 and 2) was as follows: The specimen consisted of a portion of stomach measuring 11.5 by 7.0 by 5.0 cm. Approximately in the central portion of the mucosal surface there was an ulcerated area measuring 2.0 by 1.5 cm. into which a probe could be inserted for a distance of 2.0 cm. The margins about this ulcer were somewhat thickened and indurated. Section through the ulcerated area revealed that the ulceration had eroded into a globular new growth measuring 4.5 by 5.0 by 4.0 cm. Section of this new growth revealed it to be soft, friable, yellow in color and necrotic; grossly it appeared sarcomatous in nature. The outer surface of this new growth was in general smooth and glistening. No lymph nodes were found.

Diagnosis was slowly growing leiomyosarcoma of the stomach. Portions of the tumor immediately underlying the mucosal ulceration were chronically inflamed but the deeper portions were not. The central or submucosal portion of the tumor was necrotic and formed a cavity approximately 2 cm. deep. The new growth was dominated by typically fusiform smooth muscle cells, and in addition, round or ovoid hyperchromatic cells with nuclei mostly vesicular in type were found. Mitosis was not abundant. The aforementioned cell forms were invading the mucosa, forming an ulcerated area surrounded by chronic inflammatory reaction. The deeper layers were destroyed by the new growth, but did not show any inflammation.

No further information concerning this patient is available since he did not return to the hospital and his present whereabout is unknown.

CASE II. T. P., a forty-two year old white man, was admitted with the complaint of a progressive burning sensation in the epigastric region of five months' duration. Seven years prior to admission the patient had been treated for pernicious anemia. Nine months before admission nausea developed with occasional vomiting and there was an episode of hematemesis. Moderate weight loss was noted during the last year. The epigastric burning complaints were relieved by food and soda. The patient noticed occasional black tarry stools.

Two months before this admission the patient was operated upon in another hospital and a mass was removed from the epigastrium. No report is available. Physical examination revealed marked pallor. There was distention of the abdomen; a firm, non-tender mass was found in the upper left quadrant, which moved with respiration. There were no other positive findings.

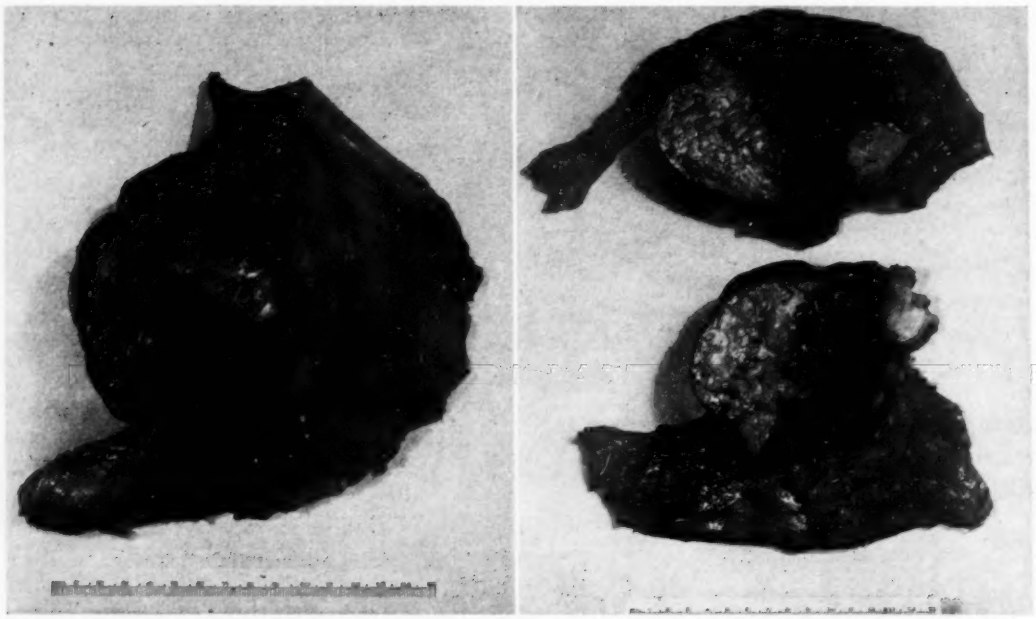


FIGS. 1 and 2. Case 1.

Blood picture showed slight hypochromic anemia; blood serum studies did not show any specific changes. Fluoroscopy showed an intragastric mass on the lesser curvature. Surgery was decided upon and total gastrectomy, partial hepatectomy, esophagojejunostomy and jejunojejunostomy were performed.

Report of the specimen removed (Figs. 3 and 4) was as follows: The specimen consisted of a previously longitudinally incised stomach and first portion of the duodenum. On the lesser curvature near the pylorus there was a huge, bulky neoplasm which measured 11.5 by 7.5 by 5.5 cm. A large, crater-like ulcer was present at the portion of the growth nearest the pylorus. The cut surface was greyish tan and had irregular linear markings. Irregularly shaped yellow plaques were scattered throughout. The tumor was quite firm except at the aforementioned ulceration. A portion of liver 1.0 by 7 by 0.5 cm. was attached to the upper portion of the external surface of the tumor. There was no evidence of lymph node involvement or local metastases.

Diagnosis was slowly growing infiltrating leiomyosarcoma of the stomach. In general, the tumor cells were well differentiated but moderate numbers of mitotic figures were



3 4

FIGS. 3 and 4. Case II.

present and the neoplasm infiltrated the entire thickness of gastric walls. In places the mucosa covering the growths was ulcerated.

The postoperative course was marked by a semi-comatose state and the periodic removal of thick, mucoid material from the bronchi. Fluid collected in the abdomen, which required drainage. The patient died on the eighth postoperative day. Postmortem examination revealed generalized peritonitis, pneumonia and splenic infarct. There was no evidence of tumor or any metastatic lesions.

CASE III. C. H., a sixty-five year old white woman was admitted to the hospital with a history of vomiting and epigastric pains of two years' duration. Four years before, on a routine physical check-up, an asymptomatic "mass on the stomach" was found. This was surgically removed and reported as leiomyoma of the stomach. The pain was relieved by meals but the nausea and vomiting became severe until the time of present admission.

On physical examination there was tenderness in the left upper quadrant of the abdomen but no palpable mass or resistance was found. There were no other positive findings. Blood counts and blood chemistry were within normal limits.

Gastrointestinal series suggested a large ulcer on the lesser curvature. Gastric analysis showed free acid in all samples, the total acidity reaching up to 68 degrees.

The patient was discharged after a short period of hospitalization on an ulcer regimen but she was readmitted three months later with a ten-day history of vomiting and pain in the epigastrium. There were tenderness and spasm in the left upper quadrant. Because of failure to respond to medical therapy surgical intervention was decided upon and subtotal gastrectomy was performed.

Pathologic report of specimen revealed the following: The specimen consisted of the distal four-fifths of the stomach measuring, unopened, 18 by 7 by 1.5 cm. in size. Two masses of the omentum with fat were attached. The proximal incision passed through the edges of a large, bulky, roughly circular neoplastic mass 6 to 7 cm. in diameter on the anterior wall of the cardia. One edge of the tumor reached and apparently crossed slightly the lesser curvature. The serosal tissue over the tumor was bulky and nodular. On section the aforementioned neoplasm proved to be a large, round, thick, deeply ulcerated carcinoma. The tumor measured 7 cm. in diameter while the ulcerated portion measured 5 to 6 cm. The edges of the ulcer were rolled upward and formed an indurated margin for the ulcer. The rest of the gastric wall was normal. The mucosa was covered with bloody mucus. Several additional tumor nodules and strips of what appeared to be mucosa were received separately.

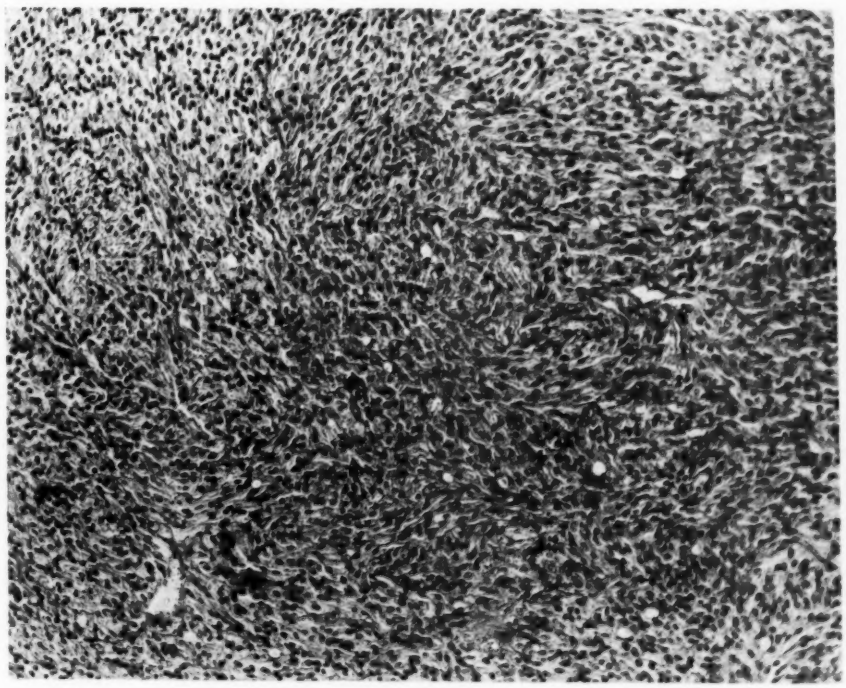


FIG. 5. Case III.

Microscopic examination of the tumor (Fig. 5) in the original specimen was composed of well differentiated, smooth muscle cells which were characteristically spindle-shaped but were mixed with ovoid and round forms. The cytoplasm showed hyperchromatosis and the nuclei were vacuolated. The tumor infiltrated the entire thickness of the stomach wall with wide ulceration of the mucosa. Mitotic figures were not frequent. The foregoing characteristic microscopic findings changed the initial diagnosis of carcinoma, which was obtained only on the gross appearance and rush sections of the not characteristic and not well differentiated changes in the lymph nodes from the omentum. The final diagnosis was infiltrating ulcerative leiomyosarcoma of the stomach.

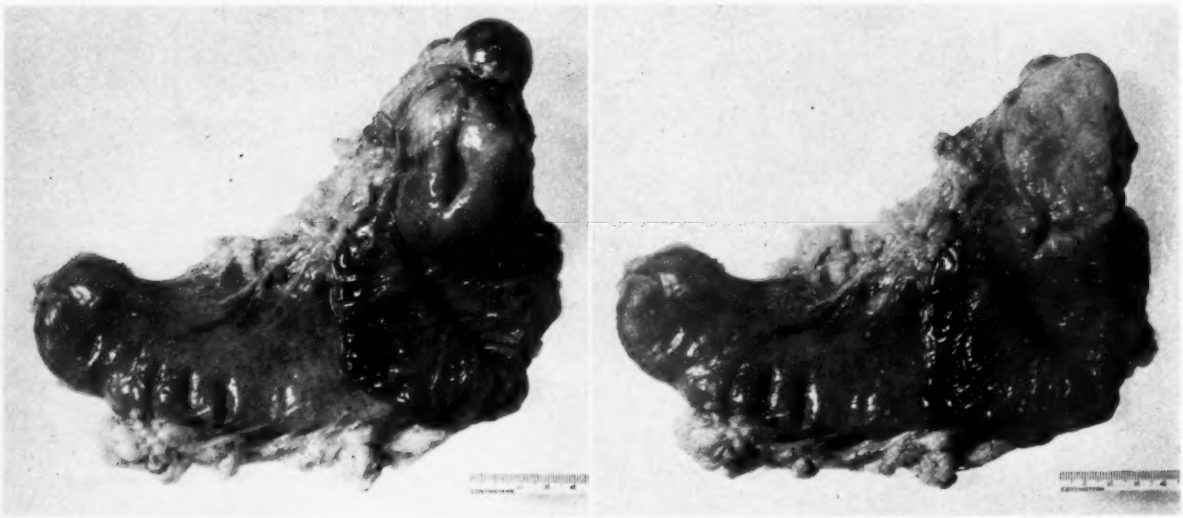
The patient had an uneventful recovery and was followed up by her family physician. According to the reports she was operated upon again in 1946, four years after the resection, and several enlarged lymph nodes were removed from the abdominal cavity. These were found to be metastatic sarcomatous tumors. The patient died in May, 1949. No postmortem examination was performed.

CASE IV. F. M., a fifty-six old white woman, was admitted to the hospital complaining of ulcer symptoms and gastric hemorrhages. During the previous eight years she had had five bouts of hematemesis, each followed by tarry stools and dizziness for a few days. There were no other symptoms and the patient was on an ambulatory ulcer diet.

In physical examination the thyroid gland was questionably enlarged. There was an indefinite tenderness in the epigastrium. There were no other positive findings. Blood counts and blood chemistries showed no remarkable changes. No free hydrochloric acid was found in the fasting gastric juice specimen, but it was present following histamine injection.

Gastrointestinal series revealed a round filling defect 8.0 cm. in diameter over which the mucosal markings were abnormal, and a tumor or bezoar was suggested. Gastroscopic examination showed smooth mucosa and no bleeding points were noted over the tumor. Surgery was decided upon, and gastrectomy and gastrojejunostomy were performed.

Pathologic examination of the specimen removed (Figs. 6 and 7) revealed the following: The specimen consisted of a stomach measuring 19 by 10 by 2 cm. which had been removed almost completely. The serosal surfaces in general were not remarkable, nor was the mucosa which showed slight congestion in the prepyloric region. In the region of the cardia along the posterior margin of the lesser curva-



6 7

FIGS. 6 and 7. Case IV.

ture there was a pedunculated tumor mass 10 by 5 by 4.5 cm. which appeared to originate within the gastric wall elevating both the mucosa and serosa. The serous surface was not ulcerated and was smooth and shiny throughout. The tumor had ulcerated the mucosal surface at one point, and it appeared almost like the cervix with a central depression and pouting surrounding lips encircling this central hole. The cut surface of the tumor was homogeneous, pale yellow, with occasional hemorrhagic foci and frequent pitted areas. On the whole the tumor was soft and apparently quite cellular. A fleshy pink nodule 1.3 by 1 by 0 cm. was dissected from the fat of the greater curvature.

The diagnosis was leiomyosarcoma of wall of stomach, focal erosion of gastric mucosa and lymphadenitis of lymph nodes of greater curvature. The tumor did not invade mucosa or regional lymph nodes. The postoperative course was uneventful.

In November, 1952, five years later, the patient was alive and well without hemorrhages or other complaints.

CASE V. J. O., a seventy-one year old white man, entered the hospital with a complaint of bloating, swallowing over a lump and vomiting mucus. The patient had a feeling of food stopping in his lower chest, fullness after eating and a sensation of food being forced through a small opening into his stomach, accompanied by gurgles and other noises. Although these had been present several months, they had become more noticeable in the two weeks before admission. There had been a weight loss of 10 to 15 pounds. One year prior to admission the prostate gland had been removed and reported as early adenocarcinoma.

In physical examination there were no positive findings. Esophagoscopy revealed a bulge on the posterior wall of the esophagus 38 cm. from the teeth. Beyond this a white, friable, fungating lesion was seen. X-ray studies also indicated a tumor of the esophagus. Surgery was decided upon and a transthoracic resection of the cardia of the stomach and the lower esophagus was performed.

Pathologic examination of the specimen removed revealed the following: The specimen consisted of a previously sectioned fungating mass of the distal esophagus measuring 8 by 8 by 5 cm., with a segment of the cardiac portion of the stomach attached. The mass occupied the mid-position of the specimen and measured 5 by 4.5 by .5 cm.

Sections showed a slowly growing but infiltrating focally hemorrhagic malignant tumor composed of either fibrous tissue or smooth muscle cells. In spite of special stains cell differentiation is difficult. The neoplasm was composed of smooth muscle cells variating with more round and atypical forms. The tumor was considered to be a slowly growing leiomyosarcoma of the gastric wall, with consideration of fibrous tissue or smooth muscle origin.

Postoperatively pyloric stenosis developed which required pyloroplasty and jejunostomy.

Three months later the patient was readmitted with abdominal pains, nausea and vomiting. Small bowel obstruction was diagnosed and was treated conservatively. The patient improved and was discharged. His final admission, four months later, found him in a terminal condition and he died after a few days in the hospital.

Postmortem examination revealed recurrence of the tumor with extensive local infiltration and widespread distant metastases, including regional lymph nodes originating in the stomach, previously removed. There were metastases to the liver, spleen and left lung. The lower lobe was encased by tumor mass 4.0 cm. in thickness. The regional lymph nodes of the inferior mediastinum and those of the stomach were the site of metastatic tumor, immobilizing the mediastinum and remaining portion of stomach. The tumor tissue itself was white, moderately firm, homogeneous and fairly vascular. The liver and spleen were riddled with round, discrete, soft-centered tumor nodules. Microscopic sections showed pictures similar to the previously removed surgical specimen. There were two predominant cell forms, either round or ovoid hyperchromatic cells with little cytoplasm, or plump, slightly fusiform cells also hyperchromatic but with more cytoplasm. The latter type radiated from thin fibrous septa or from endothelial-lined vascular channel. The nuclei were slightly vesicular and quite pleomorphic. Mitoses were not abundant. The tumor was considered to be a leiomyosarcoma of the stomach with widespread metastases.

Case vi. D. G., a fifty-seven year old white woman, was admitted after three months of epigastric pain which was irregular in onset and aggravated by hard work. She had been taking pills for anemia. The pain bore no relation to foods but fat foods caused distress and belching. There was a 6 pound weight loss and some mild jaundice; bowel movements were normal.

On physical examination there was mild tenderness and an indefinable mass in the epigastrium. The blood count showed anemia with a red count of 3,900,000. There was no free hydrochloric acid in the fasting gastric analysis specimen, but there was some in the other specimens with a high of 32 free and 72 total acidity.

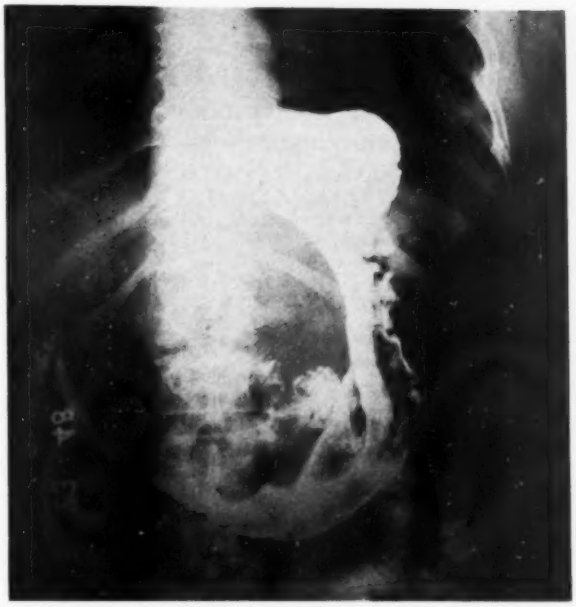


Fig. 8. Case vi. Roentgenogram showing lateral displacement of stomach, narrowed lumen and barium trickling into tumor area.

X-ray studies (Fig. 8) showed a large tumor displacing the stomach into which small amounts of barium trickled, suggesting leiomyosarcoma.

Subtotal gastrectomy was performed. A lobulated, rubbery, red and gray tumor mass was present in the gastric wall. The postoperative course was uneventful.

The specimen removed consisted of a portion of stomach, 15 by 10 by 10 cm. The wall was thickened and the lumen narrowed. The serosa was red and gray, lobular and covered a firm wall distorted by a lobular, reddish gray tumor mass with a soft granular surface.

Microscopic sections showed morphology varying from interlacing bundles of spindle cells to compact masses of rounded cells with little stroma. In some fields the cells were highly vacuolized. Nuclear size varied; mitosis was infrequent.

Four years later, in November, 1952, she was alive, symptom-free, without digestive disturbances and showed some gain in weight.

Case vii. A. P. O., a seventy year old white man, was admitted on September 25, 1950, with a history of sudden hematemesis. There had been no previous gastrointestinal symptoms. At the onset the vomiting of dark, reddish brown material was preceded by temporary weakness and loss of consciousness. The hemoglobin was 6.0 gm., the red blood

count 2.4 million. The hematocrit was 22 and the Wassermann test negative. The patient received several transfusions of whole blood.

An electrocardiogram two days after admission revealed some myocardial damage. Four days after admission a partial gastrectomy and gastrojejunostomy was performed. The pathologic report was leiomyosarcoma of the stomach.

Postoperatively the course was complicated by a pulmonary embolus but improvement resulted from dicumarol therapy and the patient was well enough to be discharged on October 18th. He was reported alive and well in January, 1953, more than two years after operation.

CONCLUSIONS

1. Leiomyosarcoma is a relatively rare gastric tumor. Diagnosis can sometimes be made preoperatively with the aid of roentgenograms and gastroscopy.

2. The treatment is resection, never radiation.

3. In those cases without metastasis, the prognosis is fairly good.

4. All patients with gastric tumors should have the benefit of biopsy, since the treatment for carcinoma, lymphosarcoma and leiomyosarcoma may be different and hence the prognosis is different.

SUMMARY

Although leiomyosarcomas of the stomach are relatively uncommon, they occur sufficiently often to warrant consideration in the diagnosis of gastric tumors. They grow slowly and metastasize late. They sometimes produce characteristic x-ray patterns, and gastroscopy may provide a different picture from other tumors. In those cases in which there is no metastasis and the tumor is totally extirpated, the prognosis is apparently good.

Of the seven cases presented herein, two patients died of metastases and one died of postoperative complications. One patient has been lost to follow-up. Three are surviving two, four and five years after surgery. In two cases the diagnosis was presumed before operation.

Acknowledgment: We gratefully acknowledge the cooperation of Drs. Ellis Kellert, J. Lewi Donhauser and Arthur W. Wright, whose assistance and encouragement were invaluable in this effort.

REFERENCES

1. Chaffin, L. Smooth muscle tumors of the stomach. Review of the literature with report of a case (leiomyosarcoma). *West J. Surg.*, 46: 513–524, 1938.
2. Marvin, C. P. and Walters, W. Leiomyosarcoma of the stomach. *Arch. Surg.*, 57: 62–70, 1948.
3. Zellhoefer, H. W. K. Leiomyosarcoma of stomach; report of case. *Proc. Staff Meet., Mayo Clin.*, 10: 625–629, 1935.
4. Marshall, S. F. and Meissner, W. A. Sarcoma of stomach. *Ann. Surg.*, 131: 824–837, 1950.
5. Lemon, R. G. and Broders, A. C. A clinical and pathological study of leiomyosarcoma, hemangioendothelioma or angiosarcoma, and fibrosarcoma of stomach. *Surg., Gynec. & Obst.*, 74: 671–680, 1942.
6. France, C. J. and Brines, D. A. Mesenchymal tumors of the stomach. *Arch. Surg.*, 61: 1019–1035, 1950.
7. Herbut, P. A. Surgical Pathology, pp. 355 and 356. Philadelphia, 1948. Lea & Febiger.
8. Yardumian, K. Primary gastric leiomyosarcoma. *Arch. Path.*, 20: 590–595, 1935.
9. Holta, A. Leiomyosarcoma ventriculi, three cases. *Acta radiol.*, 24: 166–173, 1943. Quoted by Marvin and Walters.[2]
10. Pack, G. T. and McNeer, G. Treatment of Cancer and Allied Diseases (Pack and Livingston), vol. 2, p. 1084. New York, 1940. Paul B. Hoeber, Inc.
11. Boyd, W. Surgical Pathology, 6th ed. Philadelphia, 1947. W. B. Saunders Co.
12. Lahey, F. Total gastrectomy for leiomyosarcoma; report of a case. *Labey Clin. Bull.*, 1: 4–9, 1938.
13. Lyon, C. G. and Schneider, M. Leiomyosarcoma of the stomach: report of a case. *Am. J. Roentgenol.*, 49: 393–397, 1943.
14. Bassler, A. Leiomyosarcoma of stomach; presenting four cases. *Am. J. Digest. Dis.*, 10: 342–344, 1943.
15. Palmer, E. D. Leiomyosarcoma of stomach with particular reference to gastroscopic picture. *Am. J. Digest. Dis.*, 15: 84–87, 1948.
16. Schindler, R. Leiomyosarcoma of stomach; its roentgenologic and gastroscopic diagnosis and its possible relation to pernicious anemia. *Surg., Gynec. & Obst.*, 82: 339–352, 1946.
17. Mark, J. H. Leiomyosarcoma of the stomach with excavation at the center of the tumor. *Am. J. Roentgenol.*, 67: 76–79, 1952.

PRIMARY TORSION OF THE OMENTUM*

AN OBSCURE CAUSE OF THE ACUTE SURGICAL CONDITION OF THE ABDOMEN

WILLIAM L. MARTIN, M.D., FRANK TROPEA, JR., M.D. AND THOMAS ZAYDON, M.D.
Philadelphia, Pennsylvania

IDIOPATHIC or primary torsion of a portion or all of the omentum, with circulatory compromise sufficient to cause symptoms, is a little known and rare cause of the acute surgical condition of the abdomen. Further attesting to this is the fact that this entity is seldom discussed or even mentioned in many standard texts on surgery and surgical pathology. It is believed by the authors that in some obscure cases of acute surgical condition of the abdomen in which no offending organ is found at surgery a more thorough search might reveal primary torsion of the omentum as the etiologic agent in some instances. However, due to its rarity, primary torsion is seldom ever considered as a possibility in the differential diagnosis of the acute surgical condition of the abdomen. This report is presented in the light of a recent review of the literature and clinical experience with four cases we have had on the general surgical service at Hahnemann Hospital, three cases of which are outlined in some detail in this article.

According to Aimes, omental torsion was first described in the literature in 1858 by Marchette. This case, being associated with a hernia, was of the secondary type. No definite classification was set up to distinguish primary from secondary torsion until 1899. At that time Eitel reported a case of primary torsion of the omentum occurring without any definite etiologic factor. Since that time approximately 100 cases of primary torsion have appeared in the literature. It is unquestionably true that far greater numbers have occurred than the literature indicates, many going unrecognized and undoubtedly far greater numbers surgically removed but unreported.

Omental torsion may be described as a partial or complete twisting of the omentum. This becomes clinically significant only as a result of changes associated with interference of the omental vascular supply.

In primary torsion (being also known as pure, true, idiopathic, pure intra-abdominal, cryptogenic) the exact etiology is unknown. Several theories and predisposing factors have been put forth. This type is quite rare and will be stressed in this report.

Secondary torsion, which is very commonly seen at surgery, is the type associated with or complicated by some other intra-abdominal pathologic condition or associated with a hernial sac. The secondary type may be further subgrouped into the hernial (external) and abdominal forms. The abdominal types may exist in the intrinsic (such as cysts and tumors of the omentum) or the extrinsic types (as in pathologic condition of the abdominal and pelvic organs and the peritoneum).

The foregoing classification, in the main, was advocated by Anton et al. in 1945 and is one which they believe to be sufficiently broad to take in all cases of omental torsion.

Clinical Features. The early symptoms with omental torsion are common to many other acute abdominal conditions and are primarily due to vascular obstruction of the omentum and irritation of the sensitive peritoneum. In most instances abdominal pain has been the main complaint. The location has been in any or all parts of the abdomen, depending on the site of the torsion. The greatest majority of patients with omental twisting present pain on the right side of the abdomen, most commonly in the right lower quadrant. In many of the reported cases the pain has been periumbilical. the pain is generally constant and relief is often obtained by lying down. Further, the pain is usually of only moderate severity, especially early, and does not cause great alarm to the patient. The onset, in most instances, has been very sudden, often associated with a sudden turning of the body, severe exertion or trauma. In some cases there may be a remission of the pain for some hours or

* From the Department of Surgery, Hahnemann Medical College and Hospital, Philadelphia, Pa.

even several days, while undoubtedly still others completely resolve themselves and perhaps never occur again.

There is generally no disturbance in the bowel habits. Nausea, with or without vomiting, may occur. However, very significantly, in most cases neither nausea nor vomiting is noted. It is believed by us and some other writers that this is significant in the differential diagnosis.

On physical examination marked abdominal tenderness is most always present, often with rebound tenderness. This, too, is most generally found on the right side, being more severe in the right lower quadrant. Local skin hyperesthesia is often noted. True involuntary muscle-guarding is generally not present but does occur in some cases, especially with very advanced omental changes. A mass may be palpated, generally mobile and presenting an obscure outline. The abdominal mass may be extremely difficult or impossible to find on physical examination, especially if the torsion is very small, very low, the patient very obese or in the late cases with more marked muscle-guarding and greater increase in the amount of serosanguineous peritoneal fluid. Even if a mass is palpated, it is often attributed to omental reaction about a diseased organ, a localized empyemic gallbladder or abscess of the appendix.

Fever, increased pulse and leukocytosis of varying levels may be noted. The temperature is generally not elevated very high, usually but one or two degrees. The white blood count is generally elevated from 10,000 to 15,000, with an increase in polymorphonuclears. In some reported cases the temperature, pulse and white blood cell count has been normal.

Further, omental torsion is said to occur far more commonly in males, generally between the ages of thirty to sixty, and in those who are obese.

Differential Diagnosis. There is absolutely no pathognomonic evidence which will lead us to the absolute diagnosis of primary torsion of the omentum. The preoperative diagnosis in the greatest percentage of cases has been acute appendicitis with acute cholecystitis being next most commonly considered, as the symptoms and findings most closely resemble these common conditions. At times acute pancreatitis, perforated peptic ulcer, regional enteritis, Meckel's diverticulitis or even twisted ovarian cyst has been believed to exist before surgery. Andrews has emphasized that as many as seventeen intra-abdominal conditions may be well mimicked by primary torsion of the omentum. D'Errico and others have made the diagnosis of primary torsion of the omentum preoperatively. However, it should be remembered that this is not the general rule. It must also be borne in mind, as always, that this condition may occur in association with appendicitis, as reported by Poling. In our series of four cases a mass was palpable in one case and was believed to be omental reaction about a diseased gallbladder; a preoperative diagnosis of acute appendicitis was made in two others; in one instance a true diagnosis of primary torsion of the omentum was made.

Certain factors should lead us to question, but not absolutely rule out, the omentum as the etiologic agent. Primarily, in spite of the abdominal pain and physical findings, we do not see the rapid pathologic progression seen with acute appendicitis and other common causes of the acute surgical condition of the abdomen. In effect, the pain may diminish or even completely subside on assuming the prone position. Pain generally remains in the same place and does not give the characteristic generalized or periumbilical onset with later localization in the right lower quadrant. In some cases of omental torsion the pain will continue for several days and it will be characteristically noted that the patient may not appear toxic, have no marked leukocytosis or high fever.

It is to be stressed again that other acute abdominal conditions likewise may take a similar course, varying with the organism, the particular patient and his resistance together with the treatment given during the course of his illness.

Etiologic Factors. The exact etiology of primary torsion of the omentum is not known. Many views have been advanced in an effort to explain the cause believed to precipitate this torsion. Generally, prior to onset there is a sudden rotary movement or changing of body position, and in some cases strenuous activity or trauma to the abdomen. Peristalsis, especially hyperperistalsis, is believed to entrap and twist the omentum between the viscera or the viscera and the abdominal wall. A twisting or compression of the longer, larger and more tortuous artery attempting to carry blood against increased pressure causes it to become a taut band about which the engorged, tortu-

ous venous plexus wraps in an effort to accommodate itself, and as a result the omental tissue becomes secondarily involved by these vascular dynamics, initiating and continuing a twisting of the omentum. As the pathologic change progresses, increased venous engorgement and edema of the omentum further aggravate the condition. Other factors which may play a part are obesity, omentitis and anatomic variations. These are all theories in an effort to explain a condition in which the real cause is still unknown.

Pathologic Features. The greater omentum, although it does not possess any intrinsic powers of motion, does partake in considerable activity in the abdomen, being determined mainly by outside forces. As a result the greater omentum is most generally involved in primary torsion, rarer cases being reported, of the gastrocolic and gastrohepatic omentum. The right half of the omentum is more commonly involved than the left, apparently being more susceptible to torsion due to its greater length. The torsion is generally clockwise and usually in its long axis. The actual number of turns is variable, there generally being but one complete turn. As a result of twisting there is interference with the circulation and the omentum changes from its normal pale yellowish appearance and becomes reddened and edematous, later turning dusky and bluish with congestion. With progress of the pathologic changes there is hemorrhagic extravasation, the omentum becomes purplish and there is an increased amount of serosanguineous fluid in the peritoneal cavity. Finally, there is complete vascular thrombosis with resulting gangrene, the omentum being black at this stage. Associated with the aforementioned changes, there is early aseptic peritonitis. Later bacteria from the gastrointestinal tract may involve the necrotic omentum and result in abscess formation. In a few instances autoamputation has been reported, and following this rarely parasitic adherence to an adjacent organ has been noted. It is believed that the omentum in some instances may become atrophic or is even absorbed completely. As stated previously, omental torsion undoubtedly spontaneously corrects itself in some instances.

TREATMENT

The clinical findings associated with primary torsion of the omentum make immediate surgery mandatory. Any delay may lead to progression of the local reaction, toxemia as a result of the necrotic omentum and also extensive inflammatory reaction with its resultant adhesions and associated untoward effects. It is true that some cases may subside. However, this is unpredictable and hoping for such a resolution will probably only lead to complications. A right rectus rather than a McBurney incision is recommended. If on opening the abdomen the appendix is found to be normal and the gallbladder, gastroduodenal region and pancreas cannot be incriminated as the causative agent, the omentum should always be examined, especially with the findings of serosanguineous peritoneal fluid. One should not be misled by the inflammatory reaction on the surface of an organ adjacent to pathologic omentum. This is probably one of the reasons why many cases of omental torsion are overlooked.

Treatment consists of a complete resection of the involved omentum proximal to point of rotation. Under no circumstances should the omentum with any circulatory compromise be reduced and returned to the abdomen, removing even the entire omentum if it is involved. Further, and of great importance, the omentum should be handled most gently to prevent dislodging any emboli into the circulation. After clamping the pedicle and excision of the involved omentum, the omental stump is secured with transfixion ligatures. If the patient's condition allows, in the average case, an appendectomy may also be performed. The operator should carry out a complete exploration for any associated intra-abdominal pathologic condition and especially rule out any hernia, either of which may possibly give some insight as to the cause of the omental torsion.

The outlook is generally good, the usual case going on to a completely uneventful recovery. The important factor is that this condition presents the findings of an acute condition of the abdomen, surgery is performed and the diagnosis is generally made at that time.

CASE REPORTS

CASE 1. E. A., a fifty-one year old obese white woman, was admitted because of severe pain in the right abdomen. She had had no serious medical ailments or previous surgery. One week prior to admission a rather vague, intermittent abdominal pain developed. There

had been no nausea or vomiting, and bowel movements had been normal. For several days the patient felt well; however, on the day prior to admission sudden severe right abdominal pain developed. The pain had remained constant up to the time of admission. There was but one episode of vomiting. The patient had normal bowel movements on the day of admission. No urinary symptoms were noted.

Physical examination revealed generalized abdominal tenderness. There was a palpable mass to the right of and slightly above the umbilical level, over which there was very exquisite tenderness. Muscle-guarding was present in the right abdomen. Vaginal and rectal examinations were essentially negative. A grade II apical systolic murmur was present. The lungs were clear. No other positive findings were noted.

The temperature was 100.4°F., pulse 78 and blood pressure 134/70. The red blood cell count was 3,940,000. The white blood cell count was 9,150, with 86 per cent polymorphonuclear neutrophils. The urinalysis, including the microscopic, was essentially normal.

The preoperative diagnosis was acute cholecystitis. At surgery, under spinal anesthesia, the palpable tender mass was found to be a segment of infarcted omentum. The mass measured 12 by 10 by 6 cm. in size. The torsion had involved the right lateral border of the omentum. The appendix and gallbladder were normal. With gentle handling of the involved part the base was clamped and the infarcted omentum excised. The omentum was secured with transfixion ligatures. The wound was closed without drainage. Peristalsis returned on the first postoperative day. The patient's hospital course was uneventful and she was discharged on the seventh postoperative day.

Microscopic examination: The appendix was normal. There was widespread hemorrhagic involvement and necrosis of the omentum.

CASE II. J. T., a forty-seven year old white man, was admitted with the chief complaint of abdominal pain. There had been no nausea, vomiting or change in bowel habits. Prior to this episode the patient had been in good general health. Approximately forty-eight hours prior to admission, while turning in bed, the patient developed a sudden "strained" feeling in his abdomen. There was no definite localization of the discomfort. On the morning of the day of admission sudden severe right lower quadrant pain developed, which disappeared in a few minutes. The pain recurred several hours later and persisted constantly up to the time of admission. The patient had two normal bowel movements on the day of admission. Other than some frequency, there were no marked urinary symptoms.

The physical examination was essentially negative save for the abdominal findings. The abdomen was found to be flaccid with but a moderate amount of voluntary muscle-guarding. Marked tenderness, with rebound, was noted in the right lower quadrant. No abdominal mass could be felt. Peristalsis was active. Rectal examination was negative. The temperature was 99°F., pulse 88 and blood pressure 130/92. The urine was essentially normal except for a trace of acetone. The white blood cell count was 11,750, with 84 per cent polymorphonuclear neutrophils.

Due to the nature of the onset, a low temperature in spite of the two-day history, the absence of nausea, vomiting or involuntary muscle-guarding, normal bowel movements, together with a recent experience of a previous case, we felt justified in making a preoperative diagnosis of primary omental torsion. As always, appendicitis was very strongly considered in a differential diagnosis of this patient.

At surgery a segment of twisted, infarcted omentum measuring 5 cm. in diameter was found. The infarcted segment was handled with extreme gentleness. The pedicle was clamped and the involved omentum was excised. The omental vessels were secured with transfixion ligatures. An appendectomy was performed. A routine wound closure was carried out without drainage.

Microscopic report: The omentum presented a swollen mesothelium lying on fatty tissue stroma presenting engorgement of the blood vessels and extravasation of red blood cells. There were many areas of fat necrosis and extensive inflammatory cell infiltration. On gross examination and microscopically there was no evidence of acute inflammation of the appendix. The diagnosis was infarcted omentum and normal appendix.

There was a complete uneventful recovery. The patient was discharged on the fourth postoperative day, tolerating a full diet well and having satisfactory bowel movements. The patient has remained well since that time.

CASE III. B. C., a forty-four year old white man, was admitted to Hahnemann Hospital

with the chief complaint of pain in the right lower abdomen. The patient had been well other than having occasional indigestion relieved by alkali. Approximately twenty-four hours prior to admission lower right abdominal pain developed. At the onset the pain was mild and stabbing in nature, persisting and becoming more intense up to the time of admission. The pain was aggravated by marked body movements and deep breathing. There was no associated nausea or vomiting and no change in bowel habits.

On admission the temperature was 98.8°F., pulse 78, respirations 18 and blood pressure 128/78. The red blood cell count was 5,050,000. The white blood cell count was 9,050, with 61 per cent polymorphonuclear neutrophils. Urine: specific gravity was 1.010, reaction acid and negative for protein, sugar and acetone. Microscopic examination was normal.

On physical examination the findings were essentially negative except for the abdominal and rectal examinations. The abdomen presented tenderness in the right lower quadrant on deep pressure. The abdomen was flaccid throughout. There were no palpable masses. Peristalsis was normal. Rectal examination revealed a markedly tender palpable mass.

At surgery a slight increase in peritoneal fluid was found. The appendix was not acutely inflamed; in effect it was fibrotic in appearance. No Meckel's diverticulum or other abnormality was noted until the omentum was visualized. The distal portion of the omentum, pelvic in position, presented a prominent twisted segment measuring 6 by 3 cm. in size and about 1 cm. in thickness. This portion was indurated and presented an injected and edematous appearance. The involved omentum was adherent to the adjacent viscera. The twisted segment, being handled gently, was clamped proximally, divided, and the base secured with transfixion ligatures of No. 0 chromic catgut. An appendectomy was expeditiously performed. The abdominal wall was closed in layers without drainage. Peristalsis was audible on the first postoperative day. Feedings were resumed. The postoperative course was uneventful and the patient was discharged on the fifth day after surgery, symptom-free.

CONCLUSIONS

Primary torsion of the omentum is described in the light of a survey of the literature and a review of four cases on the surgical service at Hahnemann Hospital. It is hoped that the report of this relatively rare entity will encourage its more frequent consideration in the differential diagnosis of some obscure cases of acute surgical condition of the abdomen. We believe that very often a twisted omentum is overlooked and a normal or a secondarily involved appendix or even gallbladder is removed. However, this can be easily understood when the rare occurrence of primary omental torsion is compared with the incidence of several hundred thousand appendectomies performed each year.

Our desire in the publication of this report has been to alert one to consider omental torsion as a cause of acute condition of the abdomen, especially when the more common conditions do not fit the history and physical findings presented by the patient. As always, the true importance lies in the recognition of the presence of an acute condition of the abdomen so that prompt surgery may be initiated prior to the development of gangrene, abscess formation, advanced peritonitis and toxemia.

SUMMARY

1. The importance of primary torsion of the omentum in the differential diagnosis of acute condition of the abdomen is discussed, as well as the historical background and incidence.

2. Omental torsion is defined and a classification presented. The clinical features of primary torsion of the omentum are discussed together with the laboratory findings. Factors of importance in the differential diagnosis are noted. Various theories on the etiology and predisposing causes are stated and the pathologic course is briefly described.

3. The salient features of adequate surgical treatment of primary torsion of the omentum is discussed and the prognosis is noted.

Acknowledgment: Grateful acknowledgment is made to Dr. Paul W. Grotzinger and Dr. William G. Kirkland of the general surgical service of the Hahnemann Hospital for inclusion of their cases in this report.

REFERENCES

1. Andrews, C. Torsion of the great omentum. *Nebraska M. J.*, 23: 366–369, 1938.
2. Anton, J. I., Jennings, J. E. and Spiegel, M. N. Primary omental torsion. *Am. J. Surg.*, 68: 303, 1945.

3. Barsky, E. K. and Schwartz, A. M. Primary omental torsion. *Am. J. Surg.*, 38: 356, 1937.
4. Bockus, H. L. Gastro-enterology, vol. II. Philadelphia, 1943. W. B. Saunders Co.
5. Caron, W. Primary torsion of the omentum. *Laval méd.*, 12: 481, 1946.
6. Cave, W. H. Primary torsion of the omentum, 97: 98, *Illinois M. J.*, 101: 2, 1952.
7. D'Errico, E. Primary torsion of the great omentum. *New England J. Med.*, 205: 1147–1148, 1931.
8. Eitel, C. G. A rare omental tumor. *New York M. Rec.*, 55: 715, 1899.
9. Eliason, E. L. and Johnson, J. Primary acute epiploitis. *Surgery*, 6: 68, 1939.
10. Fusco, E. M. Surgical lesions of the greater omentum. *Virgina M. Monthly*, 73: 371, 1946.
11. Jackson, A. S. Primary torsion of the omentum. *Am. J. Surg.*, 75: 849, 1948.
12. Jaroslvavsky, L., Slutman, G. and Sapisochin, E. Acute torsion of the great omentum. *Día méd.*, 18: 2036, 1946.
13. Leitner, M. J., Gordan, C. G., Spinner, M. H. and Reese, E. C. Torsion, infarction and hemorrhage of the omentum as a cause of acute abdominal distress. *Ann. Surg.*, 135: 1, 1952.
14. Payr, E. Ueber die Ursachen der Stieldrehung, intraperitoneal Gelegener Orgave. *Arch. f. klin. Chir.*, 68: 501–523, 1902.
15. Poling, R. B. Torsion of the great omentum associated with subacute appendicitis. *Obio State M. J.*, 38: 735–736, 1937.
16. Pomerbeau, O. F. Acute torsion of the omentum without hernia. Case report. *J. Maine M. A.*, 42: 292, 1951.
17. Pore, R. M. Primary torsion of the omentum. *Am. Surgeon*, 17: 841–843, 1951.
18. Wyndham, N. and Radford, J. G. Torsion of the omentum simulating appendiceal abscess. *M. J. Australia*, 26: 937, 1937.
19. Zuckerman, I. C. Primary torsion of the omentum. *Am. J. Surg.*, 75: 637, 1948.

In the hands of a skillful gastric surgeon the operative mortality of total gastrectomy is hardly greater than that of subtotal gastrectomy; however, patients undergoing the former need therapy to overcome loss of the extrinsic factor of Castle. Stoer thinks these effects are identical with deficiency of Vitamin B_{12}; hence he prescribes prompt and adequate B_{12} therapy postoperatively and reports excellent results in all his totally gastrectomized patients. (*Richard A. Leonardo, M.D.*)

PRACTICAL TECHNICS IN THE CARE OF THE BURN PATIENT*

CAPT. JOHN H. DAVIS, JR., M.C., MAJ. CURTIS P. ARTZ, M.C., CAPT. ERIC REISS, M.C. AND COL. WILLIAM H. AMSPACHER, M.C.

Ft. Sam Houston, Texas

THE principles of management of the severely burned patient have been fairly well established. The specific methods used to carry out these principles depend upon the ingenuity of the attending surgeon and his assisting staff. Several worth while technics in the care of burns have been developed during the past few years at the Burn Study Section, Brooke Army Hospital.[1] Although these technics may not be adaptable to all burns in all hospitals, their advantages are pointed out so that other surgeons who are responsible for the care of burn patients may use or modify them.

ADVANTAGES OF THE STRYKER FRAME

Since the Stryker frame was introduced at the University of Michigan Hospital in 1937,[5] it has been used widely for orthopedic and neurologic patients and is standard equipment on most orthopedic services. It was originally designed as a frame upon which a patient could be turned by one attendant. (Fig. 1.) It has been found to be of extraordinary value in the management of patients who have extensive burns.

A large burn wound is extremely painful and the Stryker frame facilitates gentle handling and turning of the patient. The patient need not be lifted in order for him to use the bedpan. The small size of the frame and its narrowness make the performance of nursing procedures easier. The linen may be changed on the posterior frame while the patient is resting on his abdomen; likewise, the linen on the anterior frame can be changed easily when the patient is on his back.

Patients who have large burns and who are required to spend a long period of time in bed are prone to decubitus ulcers. On the Stryker frame the patient may be turned four to eight times a day with ease and thus prolonged undue pressure on any one area is eliminated. When the patient is on the anterior frame, better nursing care can be given to the posterior portion of the body.[4] After grafting of the posterior portion of the body the patient may be kept on the anterior frame in comfort, and dependent edema beneath the new grafts may be prevented. Frequent changes of the patient's position may help to eliminate complications such as thromboembolism and the formation of renal calculi in the urinary tract. Although it has been difficult to evaluate the importance of the use of the turning frame in the prevention of these conditions, renal calculi were seen in only one patient and thromboembolic complications in only three in over 400 severely burned patients who have been treated in this clinic.

The frame is on wheels and can be moved easily from place to place. A great amount of discomfort is incurred by the patient in moving from bed to a cart in order to be transferred to the operating room. The use of this frame permits the patient to be taken to the operating room without moving him to a cart. He may be anesthetized on the frame and transferred to the operating table under anesthesia. This not only decreases the amount of discomfort to the patient but eliminates frequent lifting by attendants. Patients may be taken outdoors, to a television room, the movies or the physiotherapy clinic on the frame. A great psychologic benefit is obtained by the patient when he is able to be moved from place to place.

When the patient is on the anterior frame, his eyes are approximately 15 inches from the platform. This is a comfortable distance for reading and writing. The patient can feed himself comfortably while on his abdomen because the tray can be placed on the platform. (Fig. 2.) A footboard, which gives support to the feet, may be attached to the frame for patients who have severe burns of the legs. When the patient is on the posterior frame, he can grasp the overhead bar and move or adjust his position with ease. Attachments may be placed on

* From the Surgical Research Unit, Brooke Army Hospital, Fort Sam Houston, Tex.

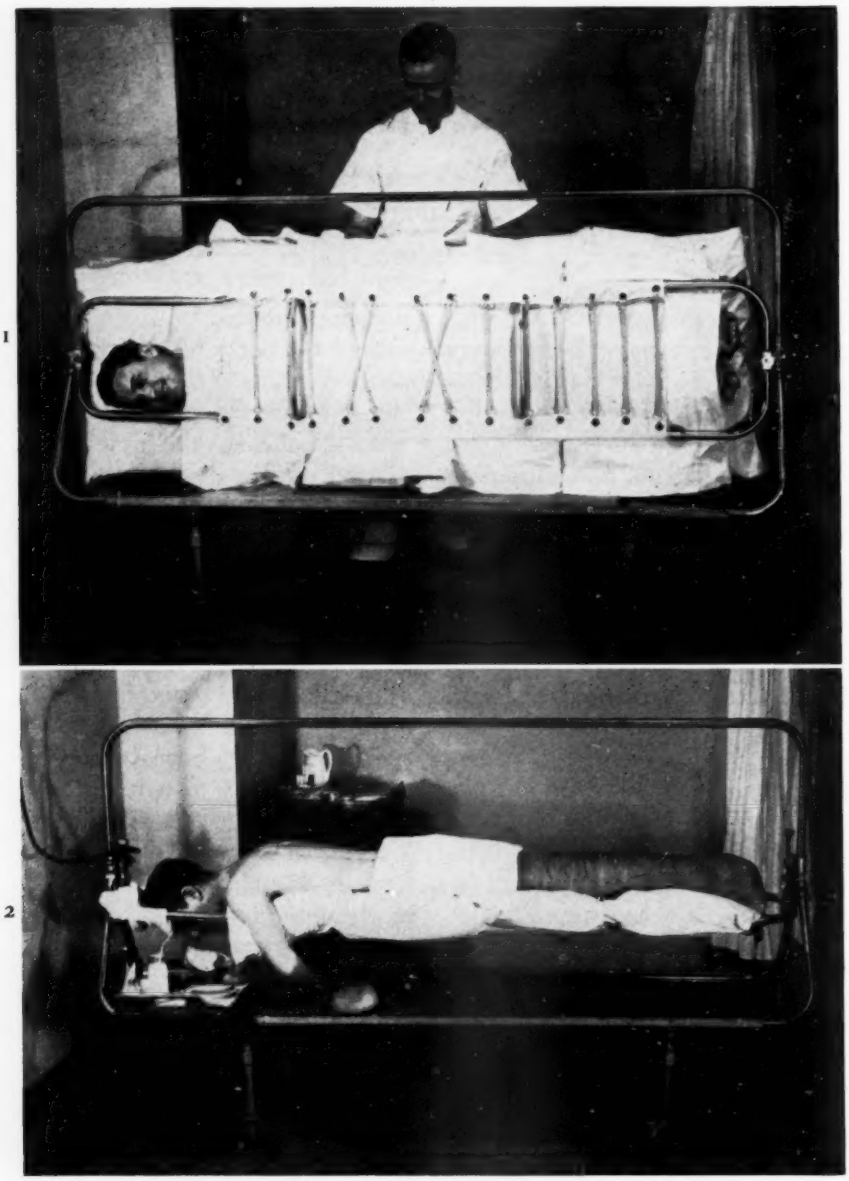


FIG. 1. Stryker frame. The patient is shown between the top and bottom frames and is in the process of being turned. Notice that one attendant can turn the patient.

FIG. 2. The patient is lying on his abdomen and eating from the tray which has been placed across the base of the frame. The distance from the eyes to the frame is also convenient for reading.

this bar so that he can do various tasks for occupational therapeutic benefit.

BROOKE BURN DRESSING

Generally an occlusive burn dressing consists of several gauze pads 4 by 4 inches, covered with abdominal pads over which a layer of mechanic's waste or fluffed gauze has been placed. If the burned area is not large and if there is only an occasional burn patient to be treated, this technic is not too troublesome. On the other hand, the application of this type of dressing is extremely time-consuming when there are several large burned areas or several burn patients to be treated. It is easier to prepare some type of large dressing pad which is made in one piece and can be applied rapidly. A one-piece dressing has been designed at Brooke

Army Hospital from easily procured items—absorbent cotton and 36 inch bolt gauze. A 1 inch layer of absorbent cotton, a section of soft fluffed gauze made by folding over several layers from the bolt, and an additional ½ inch pad of cotton are encased in a large single layer of gauze. (Figs. 3 and 4.) This dressing is thick, absorbent and very pliable. It molds well and permits the gentle application of even, resilient compression. A layer of fine mesh gauze, either dry or impregnated with an appropriate medicament, is placed over the wound before the dressing is applied. It has been found advantageous to prepare several sizes for various parts of the body, that is, whole leg, whole arm, thigh, lower leg, and upper and lower arm. (Fig. 5.) The sections for the thigh and whole leg also can be used on the trunk. These dressings are made so that they are wider at the top than at the bottom and conform more accurately to the shape of the extremity. The dressing may be constructed easily and rapidly by unskilled attendants or by volunteer workers.

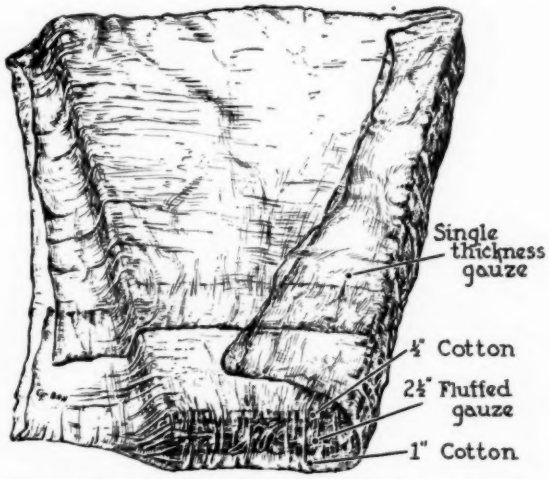


FIG. 3. Brooke burn dressing ready for application.

FIG. 4. Construction of the Brooke burn dressing.

SEMIELASTIC GAUZE CONFORMING BANDAGE

When a dressing is placed on a burned surface, it is extremely important to apply moderate resilient compression. This is difficult to obtain with the use of ordinary roller gauze bandage. Some type of heavy cotton elastic (Ace or crepe) bandage is usually used. These bandages are hot, require washing if they are to be reused, and are expensive.

A semielastic cotton gauze bandage[2] has been made by treating roller gauze bandage with concentrated sodium hydroxide. (Fig. 6.) The sodium hydroxide solution causes the cotton fibers to swell and to expand within the spiral structure of the yarn and as a result the cloth shrinks. Kinks, which increase the amount of shrinkage, form in the gauze and the fabric becomes elastic. This gauze stretches approximately 20 per cent. The surface irregularities, which result from the kinking, intermesh as each layer of bandage is added so that individual layers cannot slip. This makes the layers of bandage interlock, conform to the anatomic part and stay in position without the use of clips or adhesive. This fabric is composed of

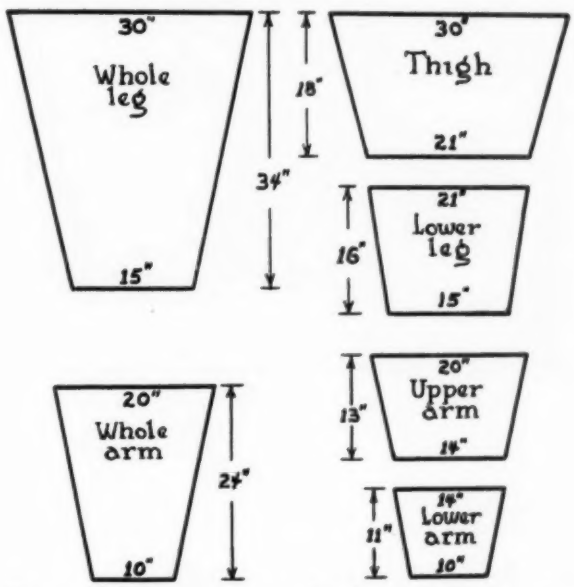


FIG. 5. The sizes of burn dressings which are convenient to keep made up, sterilized and stored for instant use. Note that they are designed to fit specific regions of the body.

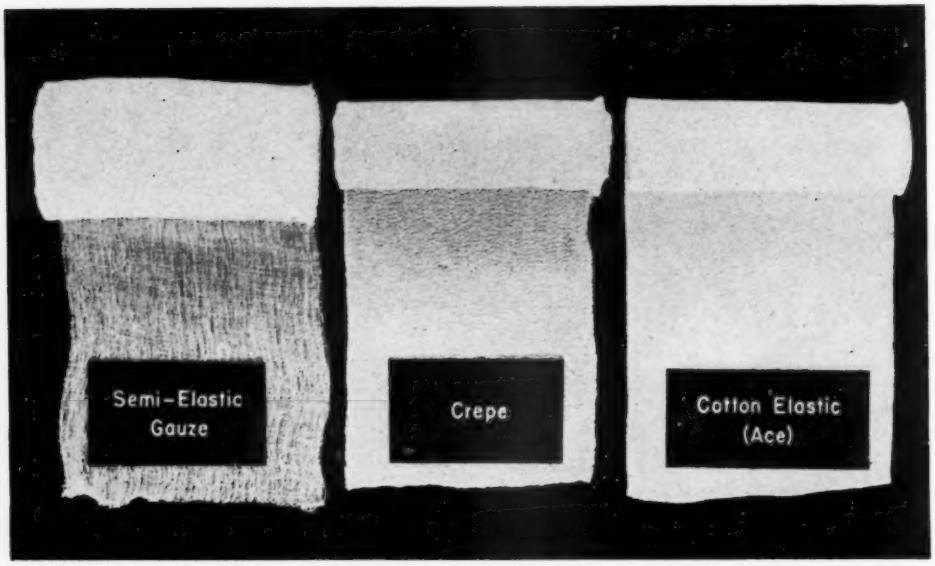


FIG. 6. Types of bandages.

100 per cent cotton and is extremely light in weight.

The semielastic gauze conforming bandage is a "throw away" bandage. It is cool, permits the application of even compression, and its use results in an appreciable saving because it is much less expensive than the cotton elastic (Ace or crepe) bandages. There is less danger of constriction when this bandage is used than when the usual elastic bandage is applied.

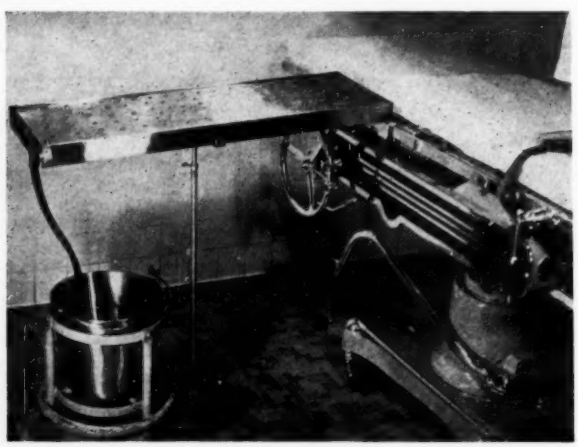


FIG. 7. Hand table. The entire table lifts off the adjustable stand and is kept wrapped and sterilized for immediate use. It is large enough to provide good working space, and deep enough for adequate drainage. It can easily be adjusted to the level of the operating table.

IRRIGATING HAND TABLE

For the management of a burned or wounded hand it is very convenient to have a table in the operating room that can be used for cleansing and irrigation. A simple hand table has been devised that may be attached to the standard operating table. (Fig. 7.) This irrigating table can easily be made of strips of stainless steel in any hospital machine shop. It consists of a lower portion or pan 36 inches long, 12 inches wide and 2 inches deep, over which is placed an operating top with many perforations. These perforations permit the fluid used for cleansing and irrigation of the wound to pass through to the pan beneath. A rubber hose is fitted to the most dependent portion of the pan so that the

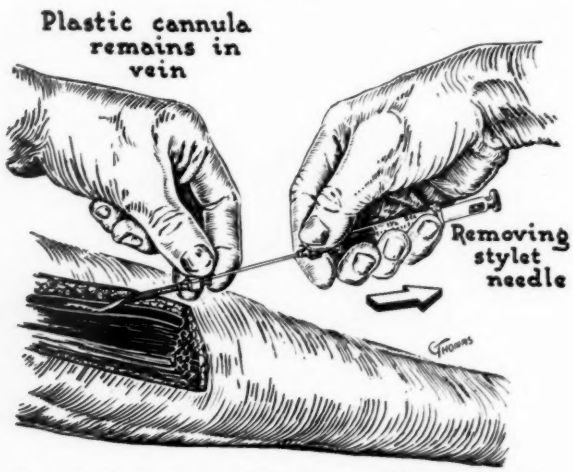


FIG. 8. Rochester needle. The needle has been inserted into the vein (shown in cutaway drawing) and the hollow needle stylet is being removed before connecting the intravenous tubing. Note how the flexible plastic needle lies in the contour of the vein without trauma to the vein wall.

excess water falls into an operating room receptacle. One end of the hand table is attached by short metal projections which fit into the side slots of the operating table. A small, adjustable stand supports the outer end. The table can be sterilized in an autoclave. After the hand has been cleansed and irrigated, the top of the table serves as an operating platform. The use of this table results in a great saving of time in the preparation of a hand or upper extremity for operation.

PLASTIC INTRAVENOUS NEEDLE (ROCHESTER)

In extensively burned patients repeated venipunctures that are required in order to administer blood and fluids are usually difficult. Frequently, after the patient has been in the hospital several weeks, it may be almost impossible to find a vein that is not thrombosed.

The plastic intravenous needle (Rochester) consists of an ordinary intravenous needle over which a hubbed segment of plastic tubing has been placed.[3] The metal needle serves as a hollow stylet and the plastic tubing becomes a cannula. This permits the easy insertion of a small plastic cannula into a vein without cutting down on the vein surgically. (Fig. 8.) The use of this needle eliminates the need for repeated venipunctures because the plastic needle may remain in place for several days. This needle can be sterilized by autoclaving; the patient is free to move about, time is saved for the physician and there is a considerable increase in the comfort of the patient. It is of particular value when prolonged intravenous administration of medication is required, especially when suitable veins are difficult to find. Since the plastic intravenous needle can be used only once, it is a rather expensive item; however, the needle which serves as a stylet can be used again.

SUMMARY

Use of the Stryker frame in the care of the severely burned patient greatly facilitates nursing care, permits frequent change of position and increases the comfort of the patient.

The use of a new burn dressing, semielastic gauze bandage, irrigating hand table and plastic intravenous needle, are worth while practical technics in the care of the burn patient.

REFERENCES

1. Artz, C. P., Reiss, E., Davis, J. H. and Amspacher, W. H. The exposure treatment of burns. (In press.)
2. Goldthwait, C. F., Kettering, J. H. and Moore, M., Jr. Semielastic cotton gauze bandage fabric. *Surgery*, 18: 507–510, 1945.
3. Massa, D. J., Lundy, J. S., Faulconer, A., Jr. and Ridley, R. W. A plastic needle. *Proc. Staff Meet., Mayo Clin.*, 25: 413–415, 1950.
4. Skinner, G. Nursing care of a patient on a Stryker frame. *Am. J. Nursing*, 46: 1–6, 1946.
5. Stryker, H. A device for turning the frame patient. *J. A. M. A.*, 113: 1731–1732, 1939.

PROSTATITIS FOLLOWING URETEROLITHOTOMY*

DAVID PRESMAN, M.D.
Chicago, Illinois

RECENTLY we have observed a late complication following ureterolithotomy in two patients which has apparently not been heretofore described. This consists of low grade prostatitis which occurs several weeks after surgery on the ureter for removal of a calculus. In order to determine the significance of this observation the records on a series of private adult male patients upon whom ureterolithotomy was performed in the past few years have been reviewed. Of a total of forty-one consecutive patients this complication developed in eight, an incidence of 19.5 per cent. Since this figure is statistically significant, the records of these eight patients were studied in detail in an attempt to analyze the clinical picture.

TABLE 1
SUMMARY OF PATIENTS IN WHOM PROSTATIS DEVELOPED FOLLOWING URETEROLITHOTOMY

Name and Age	Level of Ureterotomy	Onset of Symptoms Postoperatively (wk.)	Pyuria	Pus in Prostatic Secretion	Preoperative Cystoscopy
R. P., 40	High	6	Gross	Marked	None
L. K., 52	High	5	Microscopic	Marked	None
J. G., 51	High	3	Gross	Marked	2 days preoperatively
A. R., 44	Low	5	Gross	Marked	2 days preoperatively
A. L., 53	Low	4	Microscopic	Marked	2 days preoperatively
M. M., 54	High	8	Gross	Marked	None
A. L., 63	Low	7	Gross	Marked	None
J. N., 65	Low	3	Gross	Marked	7 days preoperatively

The salient features in each case are summarized in Table 1. The age group ranged between forty and sixty-five years. The level of the ureterotomy is apparently unimportant since there were four high and four low ureterotomies. The onset of symptoms was characteristically late in appearance, developing as a rule after the patient was home and fairly well through the convalescent period. The earliest occurred three weeks postoperatively and the latest eight weeks postoperatively. In each instance the patient complained of typical symptoms of prostatitis such as slowing of the stream, slight frequency, dysuria and perineal discomfort. In none of these patients was there any previous history suggestive of prostatitis. Routine urologic studies performed when the patients were originally seen included rectal and microscopic examinations of the massaged prostatic secretion. Both were normal in all cases.

In five cases, after the onset of prostatic symptoms a grossly cloudy urine developed which showed numerous pus cells on microscopic examination. The urine had been grossly clear in all these patients prior to onset of these symptoms. The diagnosis of prostatitis was made on each patient by the finding of a boggy prostate on rectal examination which on massage yielded prostatic secretion loaded with pus. Treatment of the prostatitis consisted of the usual measures of periodic prostatic massage and the administration of gantrisin.® The symptoms subsided in all patients and the prostatitis was cleared up within four to six weeks.

The question naturally arises as to whether urethral instrumentation could have been a factor in the etiology of the prostatitis. Although this is possible, it does not seem very likely inasmuch as four of the eight patients had no instrumentation of any kind either before or after surgery. Also, it has been our experience that as a rule prostatic reactions to cystoscopy occur within a few days and develop as acute, severe prostatitis with chills, fever and very marked local symptoms. In none of the four patients who were cystoscoped preoperatively did this acute complication arise. In the four patients who were cystoscoped the symptoms of low grade prostatitis developed from three to five weeks postoperatively. The fact that four patients had no instrumentation at any time would seem to minimize the importance of cytoscopy as a predisposing cause of the prostatitis.

* From the Department of Urology, Chicago Medical School, Michael Reese and Mt. Sinai Hospitals, Chicago, Ill.

COMMENTS

The thesis that prostatitis may occur as a direct result of ureteral surgery is admittedly speculative and difficult to prove. It would seem, however, that certain facts tend to substantiate this supposition. The relatively high incidence of this complication (19.5 per cent) in a consecutive series of forty-one patients is very suggestive of a causal relationship. The characteristic clinical picture in all of the eight patients in whom prostatitis developed is very similar in several respects. Symptoms did not appear until several weeks following surgery, the longest period being eight weeks. In most cases the urine was grossly pyuric and in each instance the massaged prostatic secretion was loaded with pus. There was no correlation with the level at which the ureterolithotomy was performed since the upper and lower portions of the ureter were involved in an equal number of cases. When all these facts are considered, it appears that there may be a definite correlation between ureterolithotomy and appearance of postoperative prostatitis.

The exact pathogenesis of the prostatitis is conjectural but certain anatomic factors may be considered. The periureteral sheath extends down to and is continuous with the fascial coverings of the prostate and seminal vesicles. Also, the lymphatics and the ureteral wall course in a longitudinal direction and anastomose distally with the lymphatics of the prostate and seminal vesicles. There is invariably some degree of infection in the ureteral wall at the site where a calculus has been lodged. Incision of the ureter to extract the stone may allow infecting organisms to invade the periureteral sheath and extend down to the prostate, thus initiating low grade prostatitis. Trauma to the ureteral lymphatics during surgery may also be a factor in the spread of the infection in a distal direction to involve the prostate. The occurrence of prostatitis following high ureterolithotomy would seem to suggest the spread of infection by the previously described pathways rather than direct extension to a contiguous structure as would follow a low ureterolithotomy.

SUMMARY

1. The occurrence of low grade prostatitis as a late complication following ureterolithotomy is described. In a series of forty-one consecutive male patients upon whom ureterolithotomy was performed this complication occurred in eight patients, an incidence of 19.5 per cent.

2. In these eight patients four high and four low ureterolithotomies were performed.

3. The clinical picture in each patient was characteristic. Typical symptoms of prostatitis appeared during the convalescent period, between three and eight weeks postoperatively. Objective findings consisted of pyuria, a boggy prostate and numerous pus cells in the massaged prostatic secretion.

4. Pathogenesis of the prostatitis is believed to be extension of infecting organisms from the site of the ureterolithotomy through the periureteral sheath and/or ureteral lymphatics downward to the prostate.

5. It is fully realized that any conclusions drawn from a small series of cases may be questionable. However, the characteristic pattern of the clinical picture in these patients is highly suggestive of a definite causal relationship. It is hoped that further observations on this subject will be made by others so that a more objective evaluation may be made.

FURADANTIN IN THE THERAPY OF GENITOURINARY TRACT INFECTIONS*

WILLIAM E. SCHATTEN, M.D. AND LESTER PERSKY, M.D.
Cleveland, Ohio

THERE is a constant stimulus to develop new antibacterial agents effective in the treatment of genitourinary tract infections. A group of these agents, the nitrofurans, were discovered by Dodd and Stillman.[1] The pharmacology, metabolism and mode of action of the nitrofurans have been studied,[2–5] and the compounds have been demonstrated to be stable, to have a low systemic toxicity and to exhibit a broad antibacterial spectrum. The first of this group designed for systemic administration was furadantin,® a synthetic chemotherapeutic agent that has the chemical designation N-(5-nitro-2-furfurylidene)-1-aminohydantoin. It is a soluble compound that can be administered orally. Studies have shown that approximately 40 per cent of an oral dose is excreted in the urine, the major portion being excreted within four hours after ingestion.[6] The urine is essentially free from the drug at the end of eight hours. It is the purpose of this study to evaluate the effectiveness of furadantin in the therapy of genitourinary tract infections.

MATERIALS AND METHODS

Studies reported here were carried out on thirty-six patients treated at the University Hospitals of Cleveland and the Cleveland State Hospital. These patients were selected because they had acute or chronic urinary tract infections. Patients having infections secondary to, or associated with, significant urinary tract obstruction or operation were not included in this study. Four patients were on constant bladder drainage because of incontinence.

Administration of all other antibacterial drugs was stopped prior to the institution of furadantin therapy. All patients with chronic infection had received previous therapy with one or more antibiotic or chemotherapeutic agents. The recommended dose of 1.75 mg. per kg. of furadantin was given orally four times a day. The duration of therapy ranged from four to twenty-eight days.

Furadantin therapy was not instituted in any case unless a positive urine culture was first obtained. After treatment was begun, urine was taken for culture every five days. In every case, following cessation of therapy, two to four follow-up cultures were secured over a period of one to two months. Cultures were obtained aseptically from both male and female patients. Urine was centrifuged and the sediment used for culturing. Each specimen thus prepared was streaked on Endo and blood agar media and then incubated; one blood agar plate was placed under anaerobic conditions. All plates were examined after overnight incubation and positive cultures were identified.

Patients receiving the drug were observed closely for symptoms of nausea and vomiting. White blood counts, hemoglobin and blood urea nitrogen determinations were done on all patients. Phenolsulfonphthalein excretions and urea clearance studies were performed on hospitalized patients. Urinalyses were done regularly to detect evidence of nephrotoxicity.

RESULTS

A total of thirty-six patients with acute or chronic urinary tract infections were treated with furadantin. The drug was symptomatically effective in all ten patients who had acute infections. (Table I.) In eight of these patients sterilization of the urine was achieved. In the other two patients the infecting organism, Proteus vulgaris, was eradicated, but repeat cultures showed a strain of paracolon in one patient and a strain of Aerobacter aerogenes in the other. (Table II.)

The drug did not effect relief of symptoms in ten of the twenty-six patients who had chronic infections. (Table I.) Sterilization of the urine was effected in only three of the patients with

* From the Department of Surgery and the Genitourinary Service, Western Reserve University School of Medicine, and the University Hospitals of Cleveland, Ohio. This work was supported by the National Institutes of Health, United States Public Health Service.

chronic disease. Pr. vulgaris was eradicated in seven of the eleven patients with chronic infections in whom it was demonstrated. (Table II.) However, repeat cultures showed sterilization not to have been achieved in six of those patients. During the course of therapy Pseudomonas aeruginosa appeared in four patients, Escherichia coli in one and Staphylococcus albus in one. There were also two patients with chronic infections in whom a strain of A. aerogenes was eradicated but follow-up cultures revealed the appearance of Ps. aeruginosa in one and paracolon in the other. The duration of treatment of the five cases in which Ps. aeruginosa appeared after eradication of the initial infecting organism ranged from eleven to twenty-eight days. The organism appeared during the first week of therapy in four instances and during the third week in the other instance.

TABLE I
RESULTS FOLLOWING THERAPY

Diagnosis	Number of Patients	Symptomatic Improvement	Laboratory Improvement	Number Sterilized
Acute pyelonephritis	8	8	8	7
Chronic pyelonephritis	6	4	4	
Acute cystitis	2	2	2	1
Chronic cystitis	5	2	2	1
Chronic prostatitis	15	10	8	2
Total	36	26	24	11

Nausea was observed in three patients; two of them had associated emesis. Repeated white blood counts and hemoglobin determinations during therapy did not reveal any cases of agranulocytosis or anemia. Urinalyses and renal function tests gave no indication of deleterious effects.

COMMENTS

Furadantin has been reported to be an effective chemotherapeutic agent in the treatment of urinary tract infections,[7,8] especially in cases in which proteus is the offending organism.[9]

The results of this study confirm the fact that furadantin is effective in eradicating proteus from the genitourinary tract. Pr. vulgaris was eradicated in ten of fourteen (71 per cent) of the patients in which it was the infecting organism. However, in eight of these ten patients (80 per cent) subsequent cultures showed the presence of other organisms. These either appeared following the eradication of proteus or they were previously masked by

TABLE II
ORGANISMS ERADICATED FROM THE GENITOURINARY TRACT BY FURADANTIN

Organism	Acute Infection			Chronic Infection		
	Strains Eradicated	Strains Not Eradicated	Strains Eradicated but Replaced	Strains Eradicated	Strains Not Eradicated	Strains Eradicated but Replaced
Pr. vulgaris	1	..	2*	1	4	6†
Staph. albus	2	..	..	3	8	..
A. aerogenes	..	..	..	1	6	2‡
Esch. coli	6	..	..	1	1	..
Alpha hemolytic streptococci	1	..	..	..	..	..
Non-hemolytic streptococci	1	..	..	2	..	..
Paracolon	..	..	..	2	1	..
Anaerobic streptococci	..	..	..	1	..	..
Total	11	..	2	11	20	8

* Pr. vulgaris replaced in 1 patient by A. aerogenes and in 1 patient by paracolon bacillus.
† Pr. vulgaris replaced in 4 patients by Ps. aeruginosa and in 1 patient each by Esch. coli and Staph. albus.
‡ A. aerogenes replaced in 1 patient by Ps. aeruginosa and in 1 patient by paracolon bacillus.

overgrowth of proteus and could be identified only following treatment. It is of interest that Ps. aeruginosa was the predominant replacing organism. Its persistence in the face of prolonged furadantin therapy shows its refractoriness to this agent.

This study indicates that the primary factor which determines the effectiveness of the drug is the nature of the disease in terms of acuteness or chronicity. This is evidenced by the number of patients in each group in whom sterilization was achieved. Although sterilization was effected in only three of the sixteen patients with chronic disease who noted symptomatic improvement, there was a concomitant change in the bacterial flora in eight of those patients.

The value of adequate follow-up studies is indicated by the fact that repeated cultures in six patients with chronic infections revealed the presence of organisms after sterilization was thought to have been previously achieved. In five other instances repeat cultures showed the presence of the initial pathogens following a period in which organisms other than they had appeared in serial cultures. In two of those cases Pr. vulgaris was the organism originally cultured.

In ten instances sterilization was not achieved despite elimination of the organisms isolated in pretreatment cultures. It is therefore believed that furadantin may not be particularly effective against many of the bacteria commonly found in chronic infections of the urinary tract. This impression is further corroborated by the failure of elimination of Staph. albus in eight of thirteen instances in which a strain was isolated, and in failure of elimination of A. aerogenes in six of seven instances in which it was isolated. It should be noted, however, that fifteen of the twenty-six patients with chronic diseases had prostatitis, which has been demonstrated to be relatively refractory to all types of therapy.

The effectiveness of furadantin against strains of proteus makes its employment in conjunction with other antimicrobial agents worthy of investigation. This effectiveness against proteus, its efficacy in the treatment of acute infections and its relatively low toxicity make it an additional useful urinary tract antiseptic.

SUMMARY

Furadantin,* a new chemotherapeutic agent, was administered orally to thirty-six patients with acute or chronic urinary tract infection. The drug effected symptomatic improvement in all of the patients with acute infections and in sixteen of the twenty-six patients with chronic infections. However, sterilization of the urine was achieved in only three of the patients with chronic diseases. Sterilization was effected in eight of the ten patients who had acute infections. Furadantin appeared to be effective in eradicating Pr. vulgaris from the urinary tract. Untoward side effects during therapy were minimal. The value of long-term follow-up studies was demonstrated by the frequent recurrence of organisms thought to have been eradicated.

Acknowledgment: The authors wish to express their appreciation to Miss Anne C. McKalen for technical assistance.

REFERENCES

1. Dodd, M. C. and Stillman, W. B. The *in vitro* bacteriostatic action of some simple furan derivatives. *J. Pharmacol. & Exper. Therap.*, 82: 11–18, 1944.
2. Krantz, J. C., Jr. and Evans, W. E., Jr. A contribution to the pharmacology of 5-nitro-2-furaldehyde semicarbazone. *J. Pharmacol. & Exper. Therap.*, 85: 324–331, 1945.
3. Cramer, D. L. and Dodd, H. C. The mode of action of nitrofuran compounds. *J. Bact.*, 51: 293–303, 1946.
4. Daily, L. E. The nitrofurans. *New York State J. Med.*, 48: 1386–1390, 1948.
5. Paul, H. E., Austin, F. L., Paul, M. F. and Ellis, V. R. Metabolism of the nitrofurans. *J. Biol. Chem.*, 180: 345–363, 1949.
6. Personal communication from Eaton Laboratories, Inc.
7. Norfleet, C. M., Jr., Beams, P. R. and Carpenter, H. M. Furadantin in infections of the genitourinary tract. Read at annual meeting of Southeastern Section of Am. Urol. Assoc., Boca Raton, Fla., April, 1952.
8. Mintzer, S., Kadison, E. R., Shlaes, W. H. and Felsenfeld, O. Treatment of urinary tract infections with a new antibacterial nitrofuran. *Antibiotics & Chemotherapy*, 3: 151–157, 1953.
9. Friedgood, C. E. and Danza, A. Furadantin in urinary tract infections due to Bacillus proteus. Read at the Clinical Congress of Am. Coll. Surgeons, New York City, September, 1952.

* Furadantin was supplied by the Eaton Laboratories, Inc., Norwich, N. Y.

THE PREFIT DOWEL INTERVERTEBRAL BODY FUSION AS USED IN LUMBAR DISC THERAPY*

A PRELIMINARY REPORT

B. R. WILTBERGER, M.D.

Columbus, Ohio

SINCE the first herniated disc operation was performed by Mixter and Barr[5] in 1934 many articles have been written expounding the virtues and disadvantages of the spinal fusion as an integral part of disc surgery. Both Bosworth and Cloward, working independently, arrived at the conclusion that the normal intervertebral disc had the function of holding the vertebral bodies apart and each one devised a very ingenious, but quite different, distraction type operative procedure designed to prevent loss of intervertebral space with subsequent narrowing of the nerve root foramen and instability with degenerative changes of the facets. It is interesting to note that Eggers'[4] principle for stimulation of osteogenesis is brought to bear in both procedures. Cloward[2] maintained the normal disc space by fusing the vertebral bodies and has done 262 vertebral body fusions in the past eight years with a reported 85 per cent permanent complete cures.

The purpose of this article is to present a preliminary report suggesting a simplified method of vertebral body fusion, the prefit dowel intervertebral body fusion. To date, several surgeons have operated upon 100 patients using this fusion technic. However, the author realizes that it is much too early to make any specific claims for a procedure not proved successful over a period of years, but the results have been gratifying and worth considering.

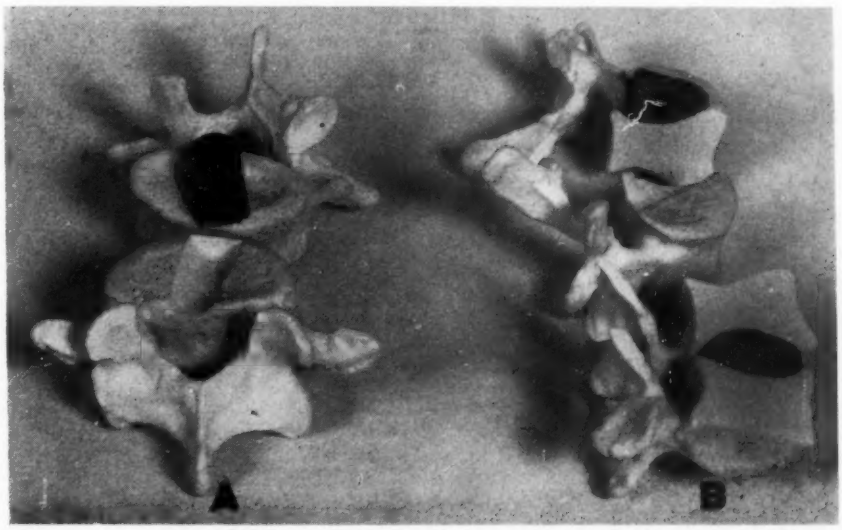


FIG. 1. A, vertebral bodies separated to show one tangentially placed oblique dowel between vertebral bodies; B, same as A, except both vertebrae sawed in anteroposterior plane, then separated to show accurate fit of oblique dowel.

OPERATIVE TECHNIC

This dowel type fusion was first used by the author as a subastragaloid Gallie fusion several years ago; and since the vertebral body fusion is quite similar, the first vertebral body fusions were done in a like manner with only one 5/8

* From The Department of Surgery, Section of Orthopaedic Surgery, The College of Medicine, Ohio State University, Columbus, Ohio.

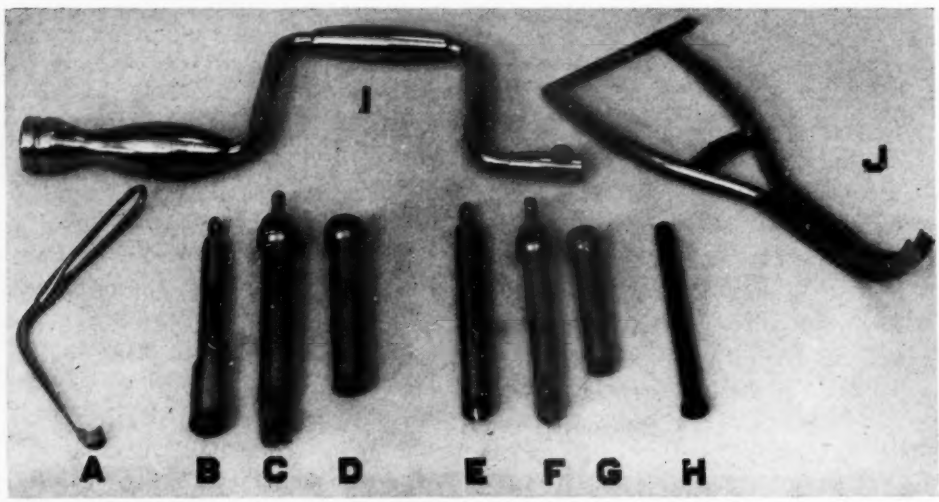


FIG. 2. A, ½ inch wide nerve root retractor: B, ⅝ inch hole saw with retractable stylet; C, ⅝ inch drill and guard sleeve; D, ⅝ inch guard sleeve alone; E, ½ inch hole saw; F, ½ inch drill and guard sleeve; G, ½ inch guard sleeve alone; H, tampon; I, brace; J, laminae spreader.

inch dowel placed tangentially between the vertebral bodies (Fig. 1A) after the ruptured disc had been removed as completely as possible.

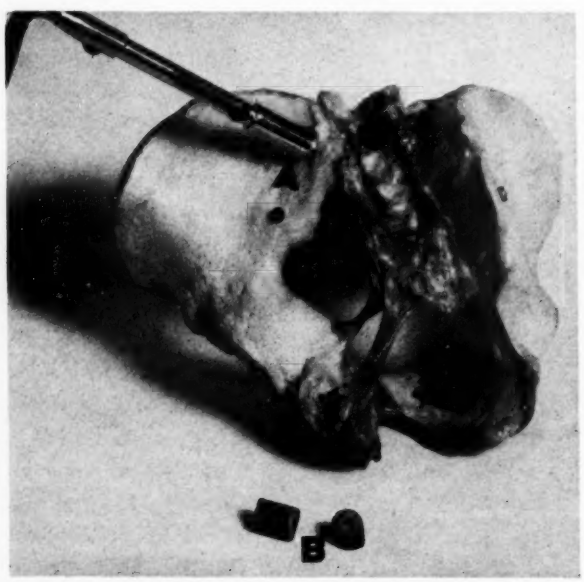


FIG. 3. A, obtaining ⅝ inch dowel by using ⅝ inch hole saw transversely through the region postsuperior iliac spine; B, ⅝ inch by ¾ to 1 inch dowels obtained as in A.

In contemplating the single dowel type fusion the preoperative x-ray is studied to determine the amount of degenerative narrowing, if any. Only in the presence of marked narrowing is the ½ inch drill used. In other cases the ⅝ inch drill is used (Fig. 2C) so that the drill will remove the cartilaginous end plates and cut well into the cancellous vertebral bodies.

After the drill and dowel size is determined, the dowel of donor bone is obtained prior to performing the laminectomy. Although some surgeons are using bone bank bone, the author prefers autogenous cancellous bone obtained by using the ⅝ inch hole saw (Figs. 2B and 3A) transversely through a stab wound in the region of the posterior superior iliac spine. (Fig. 3A.) In this area three or four dowels, ⅝ inch in diameter and ¾ to 1 inch long, can be obtained. (Fig. 3B.) The donor wound is then packed.

Then a routine unilateral partial laminectomy is performed. However, if the patient has bilateral symptoms, a bilateral procedure is done. The interspinous ligament is removed and the spinous processes of the contiguous vertebrae separated by the lamina spreader. (Fig. 2J.) With the vertebrae thus distracted the disc is easily removed as completely as possible in a routine manner.

About one-third of the superior lamina and about one-third of the medial side of the overhanging superior facet on the involved side is removed so that the ⅝ inch drill sleeve can be inserted. (Figs. 2D and 4A.) This acts as a guard to the dura and allows for only 1 1/16 inch penetration of the vertebral body. The sleeve is inserted slightly oblique beneath the dura (Fig. 4A) and the ⅝ inch drill is then placed in the sleeve and drilled until it is stopped from

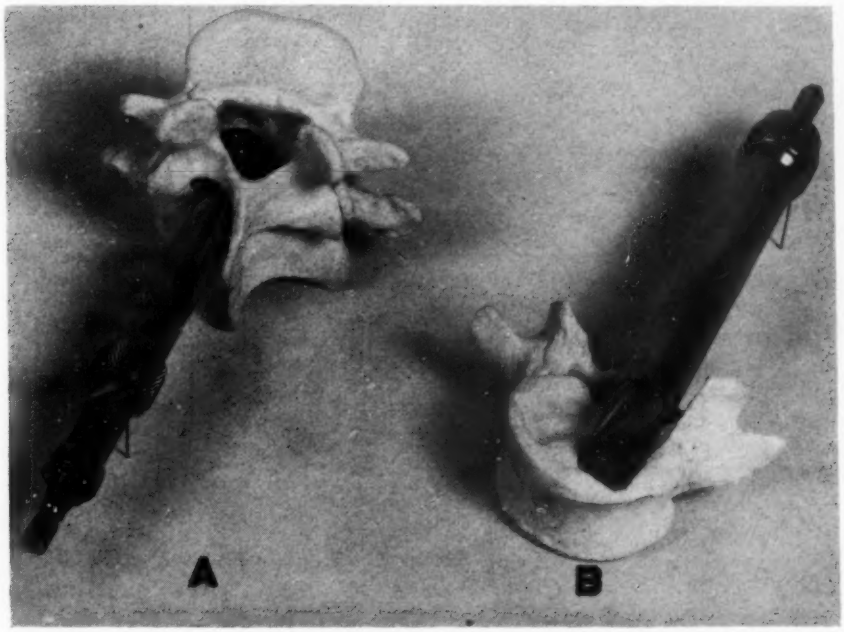


FIG. 4. A, insertion of 5/8 inch drill into 5/8 inch guard sleeve both placed oblique beneath the dura. B, showing how guard sleeve stops penetration of drill at exactly 1 1/16 inch depth. (This is from double dowel procedure through unilateral partial laminectomy so the other oblique drill hole shows.)

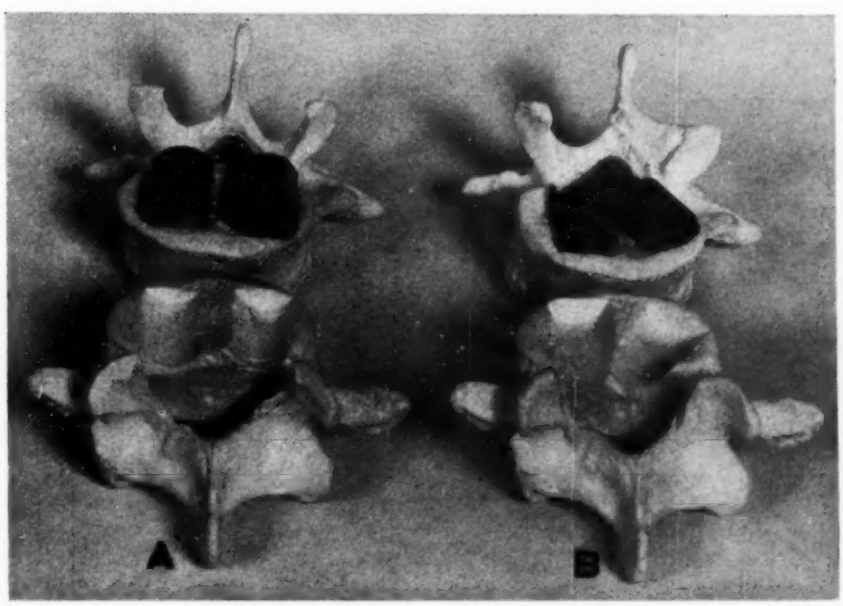


FIG. 5. A, vertebrae separated to show double bilateral dowel insertion; B, vertebrae separated to show double dowel procedure through unilateral partial laminectomy.

further penetration by the sleeve. (Fig. 4B.) (This prevents striking of the vena cava or the aorta.) The drill and sleeve are then removed and the loose debris removed from the precision 5/8 inch hole between the distracted vertebrae. The vertebrae are then distracted slightly more so that one of the 5/8 inch dowels can be inserted with the fingers. It is then pounded in firmly with a tampon and countersunk 1/4 inch.

After the lamina spreader is removed, one observes that the dowel is held in a vise-like manner and is as accurately placed as a dowel in a piece of furniture, being countersunk 1/4

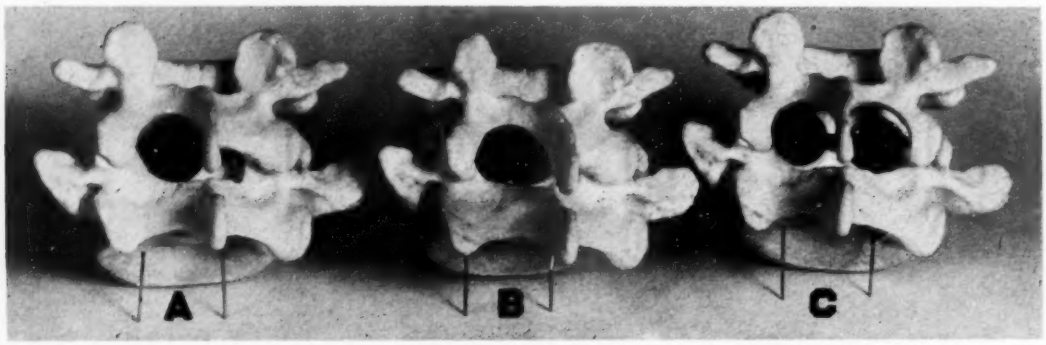


FIG. 6. A, unilateral tangentially placed oblique single dowel procedure (same as Fig. 1A); B, double dowel procedure through unilateral partial laminectomy (same as Fig. 5B); C, double dowel procedure through bilateral partial hemilaminectomy (same as Fig. 5A). It was necessary to hold these plastic models in a vise to drill them and they were drilled without being spread so more of the laminae and facets had to be removed than when doing this at the time of surgery.

FIG. 7. A double dowel fusion through a unilateral partial laminectomy. Because this is cancellous bone the dowels do not photograph well and it was necessary to outline them.

inch to prevent pressure on the dura or nerve root posteriorly.

The double dowel technic is but a modification of the single dowel operation and could be assumed to give a faster and surer fusion. In a manner similar to the single dowel operation the double dowel procedure can be done bilaterally (Figs. 5A and 6C) by straight posterior anterior drilling laterally near the facets. The two dowels can also be put in place through the same unilateral partial laminectomy by placing the first dowel in a more oblique position beneath the dura; then the second is placed in a straight posterior anterior direction laterally near the facet. (Figs. 5B, 6B and 7.)

The author prefers the bilateral double dowel operation as it causes less trauma to the nerve roots and dura provided one stays well laterally. Trauma to the cauda equina must be minimized by gentle handling of both the lamina spreader and the nerve root retractor (Figs. 2J and 2A) and pounding must be avoided.

The postoperative care has perhaps been too conservative; but since there was no precedent, it was deemed advisable to proceed cautiously. Following surgery the patient remained in bed for three weeks and was moved using the "log-rolling" technic. After the three weeks had elapsed, the patient was allowed to be up and about wearing a chair back brace for six months. Postoperative radiculitis, if present, can be reduced by intravenous procaine.

COMMENTS

The prefit dowel type vertebral body fusion is another method of distraction fusing which the surgeon may consider in contemplating herniated disc surgery. This method may be used in an effort to prevent collapse of the disc space, narrowing of the foramina with accompanying radiculitis, and instability of the facets with degenerative changes in the facets.

The vertebral body fusion is not a last resort procedure. Not only is it possible to re-enter without going through a grafted area, but also so little bone is removed in the original operation that this type fusion does not preclude the performance of another type spinal fusion should it be necessary.

The prefit dowel type fusion is not limited to spinal bone grafting but is adaptable where fusing of other joints is indicated. This method of fusion has been used twice in the arthrodesis of the subastragaloid joint.

CONCLUSIONS

1. The prefit dowel intervertebral body fusion is precision bone grafting with accurate approximation of donor and host bone and should, by its nature, be more apt to take than a less accurate graft.

2. The desirable effect which contact compression has on osteogenesis is utilized in this type fusion.

3. This type spinal fusion can be added to a laminectomy with minimal trauma because very little pounding is necessary.

4. Loss of blood is kept at a minimum for the donor site is only a stab wound with a small area of bone removed, the host site may be prepared speedily, and the dowel graft itself acts as a cork to control bleeding.

5. Trauma and blood loss are also minimized by the speed with which this operation can be performed.

REFERENCES

1. Bosworth, D. M. Techniques of spinal fusions: pseudarthrosis and method of repair. Instructional course lectures. *Am. Acad. Orthop. Surgeons*, 5: 295–313, 1948.
2. Cloward, R. B. Changes in the vertebra caused by ruptured intervertebral discs. Observation on their formation and treatment. *Am. J. Surg.*, 84: 151–161, 1952.
3. Cloward, R. B. Recent improvements in the surgical treatment of low back pain due to ruptured lumbar intervertebral discs. *Hawaii M. J.*, 2: 279–285, 1952.
4. Eggers, G. W. N. Effect of contact compression on osteogenesis. Instructional course lectures. *Am. Acad. Orthop. Surgeons*, 9: 283–293, 1952.
5. Mixter, W. J. and Barr, J. S. Rupture of intervertebral disc with involvement of the spinal canal. *New England J. M.*, 211: 210–215, 1934.
6. Shutkin, N. M. Syndrome of the degenerated intervertebral disc. *Am. J. Surg.*, 84: 162–171, 1952.
7. Jaslow, I. A. Intercorporal bone graft in spinal fusion after disc removal. *Surg., Gynec. & Obst.*, 82: 215–218, 1946.

TRAUMATIC SCAPULOHUMERAL AMPUTATION

WILLIAM VERNON WAX, M.D.

Catskill, New York

A SEARCH of the literature shows no similar case reported. This one is reported because of the extensive injury involved, the unusual recovery and the treatment followed, the type of complications, or rather, the surprising absence of severe complications following the extensive trauma and loss of tissue. A Horner's syndrome of the right eye was the most prominent of the complications arising.

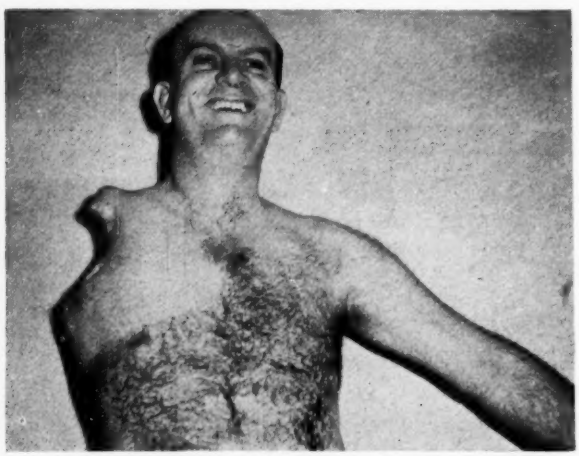


FIG. 1. Photograph taken day of discharge from hospital. Note Horner's syndrome, right eye; stump well healed.

CASE REPORT

L. D., a thirty-eight year old white man, was foreman at a cement plant. On November 15, 1951, at about 8:15 A.M., his gloved right hand was caught in a machine and his entire right arm was ripped out at the axilla together with the right scapula and attached muscles, consisting of the pectoralis major and minor, the deltoid, the subscapularis, the trapexius, a portion of latissimus dorsi with portions of the serratus major and minor as well as the supraspinatus, the infraspinatus, rhomboideus, the teres major and minor with attachments of the triceps muscle as well. The brachial plexus was laid bare and the skin was torn and macerated and covered with cement dust. The patient was unusually well developed and well nourished, his height being about 6 feet and his weight about 240 pounds.

It was only the presence of mind of a fellow employee and the ready availability of Dr. B. W. Gifford of Saugerties, New York, that were instrumental in saving this man's life. The fellow employee stopped the machinery. Dr. Gifford arrived in record time and packed the actively bleeding axillary and subclavicular area, which was completely bare as shown in Figure 1.

In retrospect, patient states that he remembers being dragged toward the machine (Fig. 2) and tried to fight it. He knew that if he allowed the machine to drag him further he would be crushed to death and he felt he had to pull away from this almost irresistible force. He consciously pulled away from the enveloping machinery and, before losing consciousness, remembers "the whole side of his body being pulled off."

He was brought by ambulance to the emergency room of the Memorial Hospital of Greene County at Catskill, New York. He was in a deep state of shock with no pulse palpable, skin cold and clammy and no blood pressure perceptible. He was given two units of plasma followed by whole blood, 500 cc., as quickly as possible. Intravenous fluids of 10 per cent G. & D. trinidex® were given while blood was being obtained.

When the packs and rags were pulled away there was active bleeding and the protruding axillary vein and artery extending into the subclavian vessels were identified, clamped with Kelly clamps and tied with No. 2 chromic individually. The exposed nerve ends of the brachial plexus were cut short and allowed to retract. It was not possible to identify the lateral, posterior or medial cords. The area was thoroughly cleansed by irrigation with phisoderm and sterile saline.

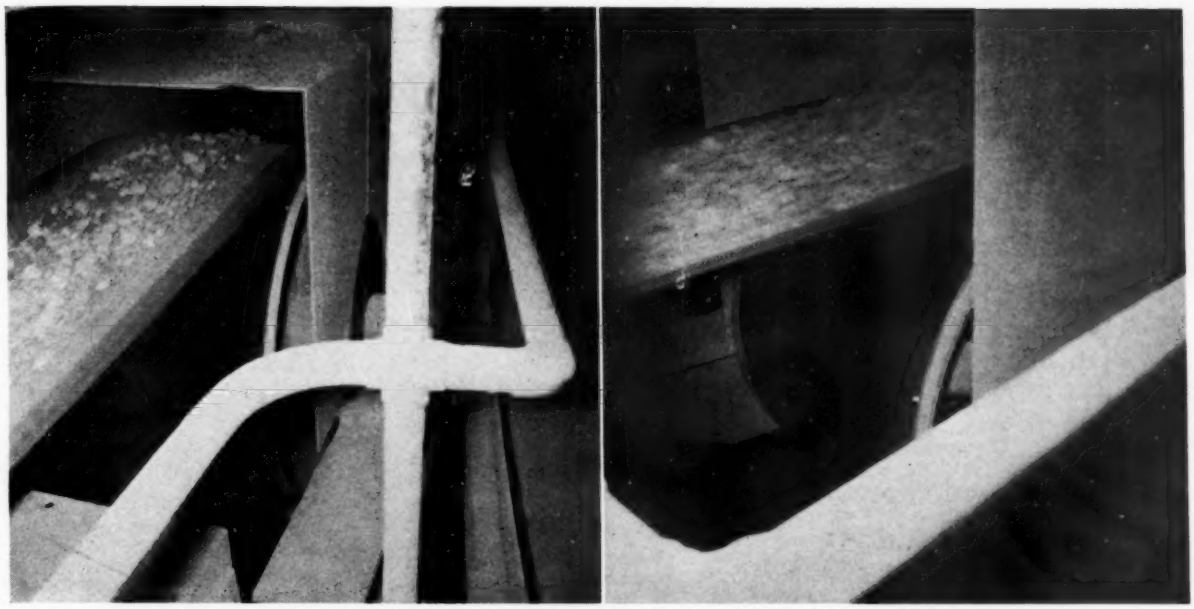


FIG. 2. Machine in which hand was caught, showing conveyor belt and guard rail.

The avulsion was of such nature as to tear out completely the musculature as described previously and the only remaining identifiable structure, apart from the ribs on the right side which were exposed anteriorly and posteriorly, was the clavicle as shown in the photographs.

The ragged ends of the muscles were débrided. A skin flap from the posterior thoracic wall was made to allow closure. Skin closure with interrupted black silk mattress sutures was performed. One Penrose cigarette drain was inserted in the most inferior portion of the wound and anchored in this area with a through and through suture. The patient was returned to his room in critical condition. Operation was performed under drop ether anesthesia. Following administration of two units of plasma, 500 cc. of whole blood and 10 per cent G. & D. trinidex, the blood pressure and pulse approached a normal level. The cold, clammy skin and the appearance of deep shock receded and the patient regained consciousness. He was placed on penicillin and terramycin therapy.

He was surprisingly free from pain in spite of the severe trauma suffered. Detailed study of pain in men wounded in battle has emphasized how misleading this generalization may be. Severely wounded soldiers show that three factors are of major importance in their suffering, namely, pain, mental distress and thirst. Only about one-fourth complained of severe pain and nearly one-third had no pain at all. Indeed, in three-fourths of the men no pain relief therapy was requested. A small dose of sedation was found in his case to accomplish

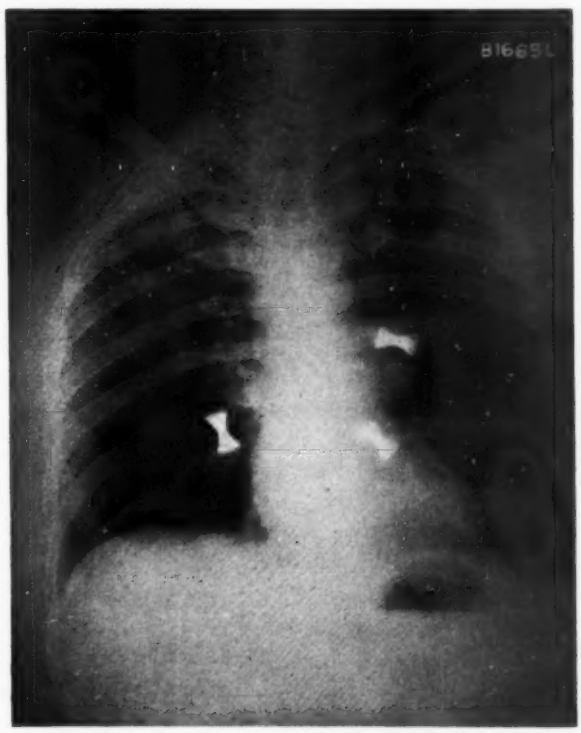


FIG. 3. X-ray of chest taken day following surgery shows extrapleural hematoma toward right apex.

what large doses ordinarily do. He complained of no pain whatever following his regaining of consciousness after intravenous therapy. These findings are emphasized unless the diagnosis of

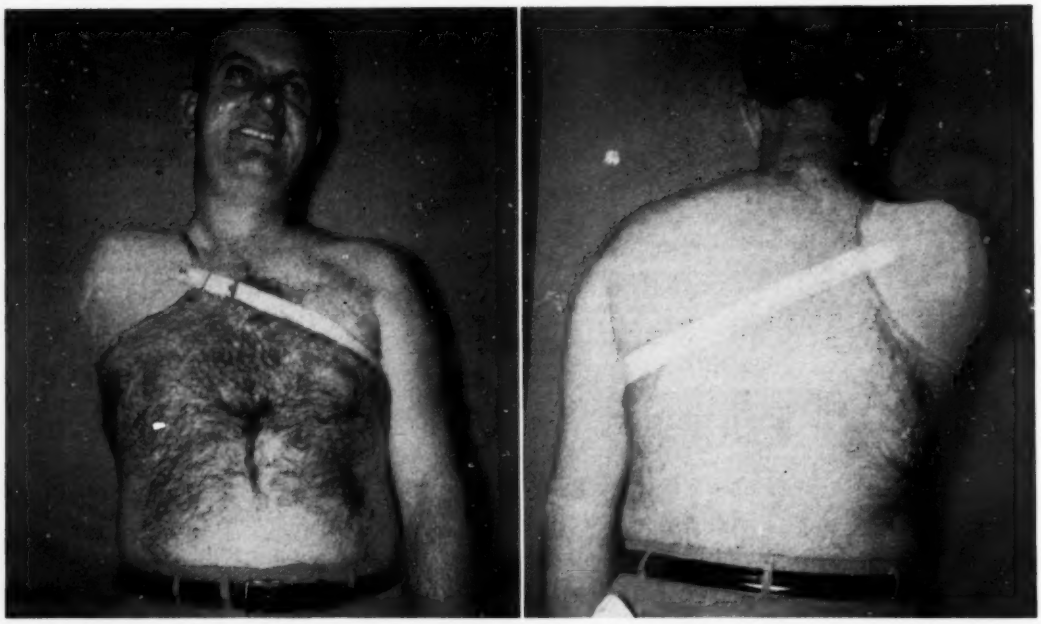


FIG. 4. Photograph taken March 15, 1953, showing shoulder prosthesis. Note evidence of Horner's syndrome, right eye.

pain be made when, in fact none is really present.

An x-ray of his chest, taken on November 16, 1951, the day following the injury, showed an "essentially negative chest except for evidence of traumatic amputation of the right arm and shoulder (scapula) and an extrapleural hematoma toward the right apex," according to the roentgenologist. (Fig. 3.)

The highest temperature rise was to 101.8°F. on the second postoperative day. Thereafter the temperature dropped to within almost normal limits in four days. Following this the patient had no further temperature rise and was discharged on the twenty-second postoperative day. The drain was removed on the twelfth postoperative day and the sutures on the fourteenth postoperative day. The wound appeared to heal uneventfully. He returned to his usual employment four weeks following his discharge from the hospital.

Shortly after his admission to the hospital it was noted that a Horner's syndrome of the right eye developed, namely, a ptosis with some exophthalmos and a contracted pupil and diminished sweating due to paralysis of the cervical sympathetic nerves.

The visual acuity of the right eye was not affected.

He was fitted with an artificial shoulder prosthesis about four weeks following his discharge from the hospital so that his coat and clothing would fit properly and he would be more comfortable. (Fig. 4.)

For about three months following his discharge from the hospital he complained of phantom pain in his right thumb and occasionally in the right wrist. These have gradually subsided and disappeared. He has been actively engaged in his usual employment as foreman in the cement plant and is very well adjusted mentally. He has since completed a new home on which he has done the major portion of the work and he is well adjusted to his surroundings in his home as well as his employment.

SUMMARY

1. This thirty-eight year old adult white male was caught in machinery while at work in a cement plant. The right humerus, scapula and all attached musculature were completely avulsed. He was brought to the hospital in a state of deep shock and it appeared as though he would not survive. No similar case is reported in the literature where the entire shoulder girdle was ripped away with avulsion of the amount of tissue loss in this case, with survival.

2. Had it not been for immediate first aid

at the plant and the rapid attendance by a physician this would have been another industrial accident death.

3. The patient complained of no pain until he was completely out of shock reaction. The existence of pain is often taken for granted, especially when the patient has suffered a severe trauma. The only pain he complained of was at a late date and this was a "phantom pain" in the amputated hand and fingers which subsided in time.

4. Horner's syndrome appears to have remained constant without any appreciable recession, due to injury to the cervical sympathetic nerves.

5. The patient is now back at work at his usual job as a foreman at a cement plant and is well adjusted.

MECONIUM peritonitis is a rare but interesting condition with which surgeons should be familiar. Meconium and intestinal peristalsis are present before the fetus is three months old. Perhaps the peristalsis is responsible for a tear in the intestine; this permits the sterile meconium to spread throughout the abdominal cavity causing aseptic, chemical peritonitis. If the intestinal tear occurs early in intrauterine life, a stillbirth results. If the meconium peritonitis occurs at birth or shortly thereafter, contamination with bacteria will complicate the picture but prompt surgery may be curative. (*Richard A. Leonardo, M.D.*)

Streamlined Article

CANCER OF THE THYROID

DIAGNOSIS AND TREATMENT

ROLAND T. SMITH, M.D.
Joplin, Missouri

A NODULE in a thyroid should be excised, regardless of its size, duration or age of patient. In an adult a non-toxic nodule is malignant in 10 to 17 per cent of the cases or more. In children these nodules are malignant in around 30 per cent. The greatest number (about 46 per cent) of malignancies of the thyroid are papillary adenocarcinoma and these are the least malignant. The most malignant seems to be the giant cell carcinoma, (in these the five-year survival rate may be zero). The other types, follicular, alveolar, solid, Hürthle cell and unclassified, fall somewhere in between the above two. Normal looking thyroid tissue in the lateral aspect of the neck (so-called lateral aberrant thyroid) probably is malignant and must be treated so.

The proper treatment for carcinoma of the thyroid is total removal of the lobe involved, sub-total on the other side, and radical neck dissection of involved side including removal of sternocleidomastoid, omohyoid, sternothyroid and sternohyoid muscles, the internal, external and anterior jugular veins and all adjacent lymphatic tissue in block dissection (removal of spinal accessory and one recurrent nerve if involved), followed by irradiation. Better results would be obtained in preventing carcinoma of the thyroid and treating carcinoma of the thyroid if this plan were followed more often.

* * * *

The proper treatment for a nodule in the thyroid gland is its complete excision. Regardless of the size of the nodule, duration of its existence or age of the patient it is often impossible to tell whether the nodule harbors malignancy, thus it must be removed. Thyroid tissue in the lateral aspect of the neck, the so-called lateral aberrant thyroid, merely represents a benign looking metastasis from a carcinoma of the thyroid until proven otherwise. A nodule in a thyroid of a child is even more apt to be malignant: in a child with a non-toxic nodule in the thyroid the chance of its being malignant is around 30 per cent. In an adult a non-toxic nodule is malignant in 17 per cent of the cases or more. In one series of 380 cases of solitary non-toxic nodules 25 per cent were malignant. The figure 4 to 5 per cent which has often been quoted as the incidence of malignancy in goiters applies to all types of goiters: toxic nodular goiter, non-toxic nodular goiter, non-toxic diffuse goiter (colloid goiter or adolescent goiter), and toxic diffuse goiter (Graves' disease or exophthalmic goiter). It is in the last two types (colloid and Graves') that carcinoma is unusual.

In general the proper treatment for carcinoma of the thyroid is total removal of the lobe involved, sub-total on the other side and radical neck dissection of the side involved which includes removal of most of the sternocleidomastoid muscles and omohyoid muscles, sternothyroid and sternohyoid muscles, internal jugular vein and all adjacent lymphatic tissue in block dissection (removal of one recurrent nerve if involved), followed by irradiation. If both sides of the neck have involved nodes or lobes a total neck dissection should be done in stages with the exception that one internal jugular vein should be left if not involved. (The removal of both internal jugular veins simultaneously has been done successfully with immediate removal of cerebrospinal fluid to maintain a safe intracranial pressure.) Even if distant metastasis has taken place, it may be indicated to do a rather complete local removal of the tumor and thyroid so that the

uptake of radioactive iodine may be greater in the metastasis. There are at least two opinions on this, namely, that all carcinomas of the thyroid with distant metastasis should be treated this way, with preliminary thyrotrophic hormone, and that only in cases of well differentiated carcinoma should radioactive iodine be given. The papillary carcinomas that have colloid are said to have the best affinity for radioactive iodine. It has been suggested that radioactive iodine be administered preoperatively in cases of suspected metastasis from carcinoma of the thyroid so that the metastasis could absorb the iodine enough to be recorded on a Geiger counter and thus help prove the presence of the metastasis.

Previously radical neck dissections were not thought proper, but now the majority of evidence accumulated shows that the radical dissection followed with x-ray gives better results. From many examples of this fact is the following: In Europe the five-year survival rate for carcinoma of the thyroid is much less than that in clinics in the United States where radical neck dissections are done and all thyroid nodules are removed. In Europe very few dissections are done and non-toxic nodules are usually not treated surgically.

By way of illustration a typical case of retrosternal malignant goiter with lateral metastasis to the neck that was treated in the aforeprescribed manner is presented. It was a case of papillary cystadenocarcinoma with a large (5 by 5 cm.) mass attached to the sternocleidomastoid, and another mass arising from the isthmus mostly retrosternal. The majority (about 46 per cent) of malignancies of the thyroid are papillary adenocarcinoma and that is fortunate in that these are the least malignant, (five-year survival rate—20 to 80 per cent: 20 per cent for those diagnosed preoperatively and 90 per cent for those diagnosed by the pathologist provided they are treated as recommended; apparently less otherwise). The most malignant seems to be the giant cell carcinoma; in one large series of 301 cases of carcinoma of the thyroid in which 10 per cent were due to giant cell tumor, there was a 100 per cent mortality, the average length of life being four to eight months. The follicular and alveolar carcinomas are difficult for the pathologist to diagnose since they are so orderly, but months or years later distant metastases may appear, (the five-year survival on these is 28 to 45 per cent when treated). It is also fortunate that these comprise only about 7 per cent of the carcinomas. The solid adenocarcinoma, Hürthle cell and unclassified carcinoma make up the remaining one-third.

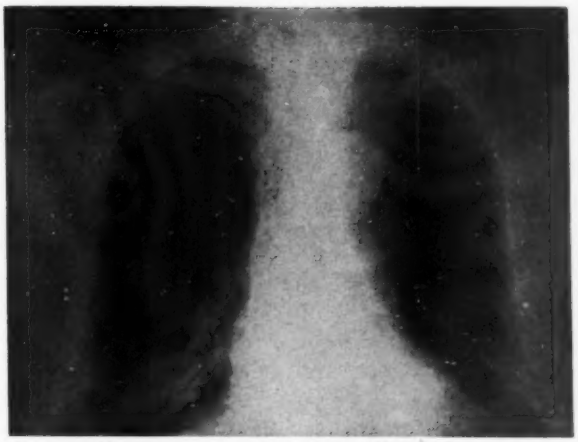


FIG. 1. Chest x-ray. There is a diffuse homogeneous mass causing a fullness in the left side of the neck representing the lymph node metastasis (5 by 5 cm.) attached to the sternocleidomastoid muscle. There is also a diffuse homogeneous mass 5 by 5 cm. behind the left side of the manubrium representing the primary tumor arising from the isthmus.

CASE REPORT

E. H., a sixty-seven year old man, had noticed a gradually enlarging mass (as described previously) in the left side of the neck for about one year. He did not realize he had another lump near the midline. After complete check-up the following diagnoses were made: umbilical hernia, prostatic hypertrophy, obesity, cataract of the left eye, essential hypertension, varicose veins and arthritis. The vocal cords were normal.

Laboratory data were as follows: basal metabolism rate was plus 19; chest x-ray revealed (Fig. 1) a retrosternal mass to the left of the midline and a large mass in the left side of the neck, the aorta was sclerotic; electrocardiogram was normal; urine revealed a few white blood cells.

Under cervical plexus procaine block and local infiltration supplemented with endotracheal oxygen and a small amount of pentothal® in the last thirty minutes, a low cervical curved transverse incision was made and a mass invading the left sternocleidomastoid muscle was exposed. A frozen section was taken which proved to be papillary adenocarcinoma of the thyroid. (Fig. 2.) The incision was then curved upward over the sternocleidomastoid muscle

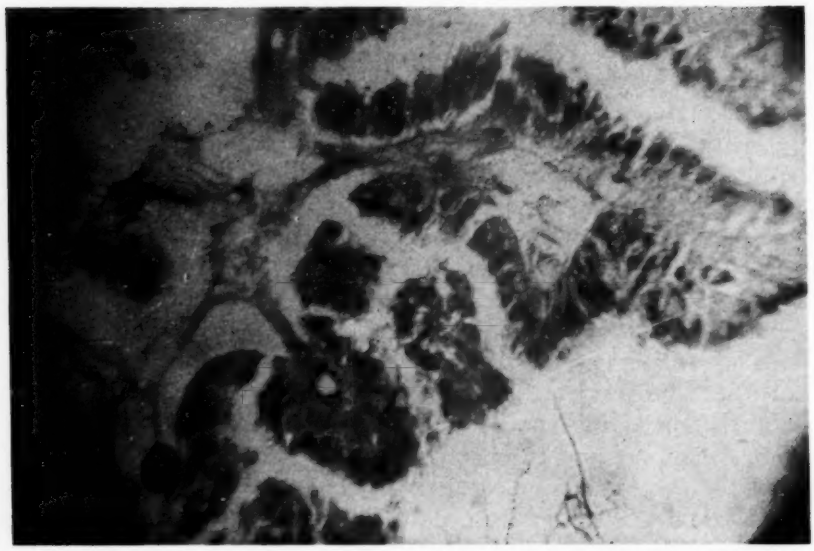


FIG. 2. Photomicrograph of a portion of the cyst wall from the side of the neck. It is lined with papillary structure covered with columnar epithelial cells, some of which show a considerable amount of anaplasia. In one area there are some cells invading a vein. The wall of this cyst is made up mainly of fibroblasts, but scattered throughout are some cells the major portion of which appear to be young fibroblasts. A small lymph node was noted in one section which did not reveal any tumor tissue. Sections taken from the mass arising from the isthmus show a capsule that is made up entirely of fibrous connective tissue; there are also papillary structures which stimulate the structures found in the main mass. However, this mass is very well encapsulated and the pathologist was unable to demonstrate any cells in the veins. Diagnosis was papillary carcinoma of the thyroid.

to the mastoid process and skin flaps raised above and below and to the side. The following were then removed in block dissection: most of the sternocleidomastoid muscle, the underlying mass, all adjacent lymphatic tissue, most of the omohyoid muscle, the internal jugular vein, the left sternohyoid and sternothyroid muscles; total lobectomy was done on the left. Then the isthmus and the mostly retrosternal mass were removed and a subtotal lobectomy done on the right. The wound was thoroughly irrigated with saline. A split Penrose drain was placed in the wound and brought out of the side of the neck. The skin was approximated with clips.

The postoperative course was complicated somewhat the next morning by the fact that a stridor developed and the patient became cyanotic. Tracheotomy was then performed and the patient's course was very satisfactory thereafter. The clips were removed on the third postoperative day and the patient discharged from the hospital on the tenth day with the tube in the trachea. Irradiation therapy was begun on the fourteenth day and he received 2,800 r in divided doses every other day for eight doses at which time the esophogus was so irritated the patient had difficulty swallowing water. X-ray, therefore, was discontinued temporarily. The tracheotomy tube was removed and the tracheal fistula closed completely.

It is now about nine months since the operation; the patient is working in his grocery store and feels fine in general. His two complaints are that there is some pain in the neck on lifting the left arm above 60 degrees and that there is a little edema under the jaw.

Addendum: In a case of a small (2 cm.) toxic malignant goiter present for fifteen years which was operated upon recently, there was a small lymph node that contained a metastasis under the lower end of the sternal thyroid muscle. The node was not palpable preoperatively or during the thyroidectomy. This emphasizes the need for radical neck dissection in all cases of thyroid cancer.

Due to the influence of recent reports only the inner half of the sternal mastoid muscle was removed. The deformity and permanent disability from the operation were nil.

REFERENCES

1. Anglem, T. J. and Bradford, M. L. Nodular goiter and thyroid cancer. *New England J. Med.*, 239: 213, 1948.
2. Beahrs, O. H. and Judd, E. S., Jr. Malignant lesions of the thyroid gland. *S. Clin. North America*, 31: 1169, 1951.
3. Beotelsen, A., Christensen, E. and Eskelund, V. Carcinoma of thyroid, contribution to its clinical picture, histopathology, treatment, and prognosis. *Acta chir. Scandinav.*, 99: 205, 1949.
4. Bliss, W. R. and James, A. C. Metastasizing struma. *Surgery*, 30: 850, 1951.
5. Brown, B. and McDowell, F. Neck dissection for metastatic carcinoma. *Surg., Gynec. & Obst.*, 79: 115, 1944.
6. Cattell, R. B. Indication for neck dissection in carcinoma of thyroid. *J. Clin. Endocrinol.*, 10: 1099, 1950.
7. Cole, W. H., Slaughter, D. P. and Majarakis, J. D. Carcinoma of the thyroid gland. *Surg., Gynec. & Obst.*, 89: 349, 1949.
8. Cole, W. H., Majarakis, J. D. and Slaughter, D. P. Incidence of carcinoma of the thyroid in nodular goiter. *J. Clin. Endocrinol.*, 9: 1007, 1949.
9. Cope, O., Dobyns, B. M., Hamlin, E., Jr. and Hopkirk, J. What thyroid nodules are to be feared. *J. Clin. Endocrinol.*, 9: 1012, 1949.
10. Crile, G., Jr. Indication for removal of nontoxic nodular goiter. *J. A. M. A.*, 139: 1247, 1949.
11. Crile, G., Jr. Cancer of thyroid. *J. Clin. Endocrinol.*, 10: 1152, 1950.
12. Dargent, M. Thyroidectomy with block dissection of neck for carcinoma of thyroid gland. *Lancet*, 2: 721, 1948.
13. Frazell, E. L. and Foote, F. W. The natural history of thyroid cancer (301 cases). *J. Clin. Endocrinol.*, 9: 1023, 1949.
14. Goldman, L. Experiences with thyroidectomy in thyroid clinic. *J. Clin. Endocrinol.*, 8: 781, 1948.
15. Guis, J. A. and Gner, D. H. Venous adaptation following bilateral radical neck dissection with excision of the jugular veins. *Surgery*, 28: 305, 1950.
16. Hare, H. F. and Newcomb, R. V. Carcinoma of thyroid in children. *Radiology*, 54: 401, 1950.
17. Hare, H. F. and Salzman, F. A. Cancer of thyroid: ten to twenty year follow-up. *Am. J. Roentgenol.*, 63: 881, 1950.
18. Jackson, A. S. Carcinoma of thyroid gland. *Arch. Surg.*, 58: 875, 1949.
19. Kreutzer, F. L., Miller, E. R., Soley, M. H. and Lindsay, S. Histologic localization of absorbed radioactive iodine in some human thyroid diseases. *Arch. Surg.*, 60: 707, 1950.
20. Lahey, F. H. and Hare, F. F. Malignancy in adenomas of the thyroid. *J. A. M. A.*, 145: 689, 1951.
21. Lahey, F. H. and Hoover, W. B. Tracheotomy after thyroidectomy. *Ann. Surg.*, 133: 65, 1951.
22. Lange, H. J. and Maclean, K. F. Malignant neoplasms of the thyroid. *Surgery*, 26: 862, 1949.
23. McClintock, J. C. and Farrell, J. J. Relation of single nodule to cancer of thyroid gland. *New York State J. Med.*, 49: 516, 1949.
24. McCort, J. J. Interthoracic goiter: its incidence, symtomatology and roentgen diagnosis. *Radiology*, 53: 227, 1949.
25. Miles, G. O. and Hansha, W. N. Management of thyroid carcinoma. *Am. Surgeon*, 18: 117, 1952.
26. Morfit, H. M. Simultaneous bilateral radical neck dissection. *Surgery*, 31: 216, 1952.
27. Pemberton, J. deJ. and Black, B. M. The association of carcinoma of the thyroid gland and exophthalmic goiter. *S. Clin. North America*, 28: 935, 1948.
28. Perloff, W. H. and Scheenberg, N. G. The problems of thyroid carcinoma. *Surgery*, 29: 572, 1951.
29. Perzik, S. L. Simultaneous bilateral radical neck dissection with recovery. *Surgery*, 31: 297, 1952.
30. Rawson, R. W., Marinelli, L. D., Skanse, B. N., Trunnell, J. and Fluharty, R. G. Effect of total thyroidectomy on function of metastatic thyroid cancer. *J. Clin. Endocrinol.*, 8: 826, 1948.
31. Ward, G. E. and Hendricks, J. W. Tumors of Head and Neck. Baltimore, 1950. Williams & Wilkins.
32. Ward, G. E., Hendricks, J. W. and Chambers, R. G. Carcinoma of the thyroid gland. *Ann. Surg.*, 131: 573, 1950.
33. Warren, S. and Feldman, J. D. Nature of lateral "aberrant" thyroid tumors. *Surg., Gynec. & Obst.*, 88: 31, 1949.
34. Zimmerman, L. M., Wagner, D. H., Perlmutter, H. M. and Amromin, D. G. Benign and malignant epithelial tumors of thyroid gland. *Arch. Surg.*, 60: 1183, 1950.

Case Reports

HERNIATION OF THE LEFT AURICLE*

COMDR. WESLEY FRY, M.C.
Oakland, California

AN interesting case of herniation of the left auricle through a defect in the pericardium is presented because of the unusual nature of this condition and because of the difficulty in making an accurate evaluation of the condition before operation.

FIG. 1. Postero-anterior roentgenogram of chest showing mass in the vicinity of pulmonary conus which at operation was proved to be a herniated left auricle.

CASE REPORT

A white man, twenty years of age, was referred to this hospital with a diagnosis of "mediastinal mass" after an x-ray of the chest an abnormal shadow in the region of the conus arteriosus. The patient was asymptomatic. Studies in the hospital confirmed the roentgenographic finding. (Fig. 1.) The history and physical examination provided no lead as to the diagnosis. The usual laboratory examinations yielded results within normal limits. Cardiac fluoroscopy was performed with barium swallow. By this examination it was not possible to separate the mass in the vicinity of the left pulmonary artery from the cardiac silhouette. In fact the mass was observed to pulsate. The roentgenologist believed that the mass probably represented hilar lymph nodes and, possibly, lymphoma. Lateral views of the chest were of no help in localizing the mass visible in the postero-anterior film.

Pursuant to our policy that necessity exists for exploration and surgical removal of mediastinal masses when they cannot be proved to be innocuous, a left thoracotomy was performed upon this patient. A preoperative diagnosis of mediastinal tumor was made.

At operation when the left lung had been retracted posteriorly, exposing the anterior mediastinum, the auricular appendage of the left atrium was found to be in the pleural cavity. (Fig. 2.) There was a small defect in the pericardium through which the auricle protruded. The auricle appeared to be somewhat larger than average size. It was extremely irritable as evidenced by the fact that touching it resulted in arrhythmia of short duration. Bathing the auricle with 1 per cent procaine solution rendered the auricle less irritable and it was possible to explore the pericardial defect digitally. A finger passed readily into the pericardial sac through the abnormal hiatus with-

* From the Surgical Service, United States Naval Hospital, Oakland, Calif. The opinions expressed are those of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

out constricting the auricle unduly. The heart was free from the pericardium all around the defect. There was no evidence of thrombosis on inspection and palpation of the auricle.

The question of replacing the auricular appendage and closing the pericardium then

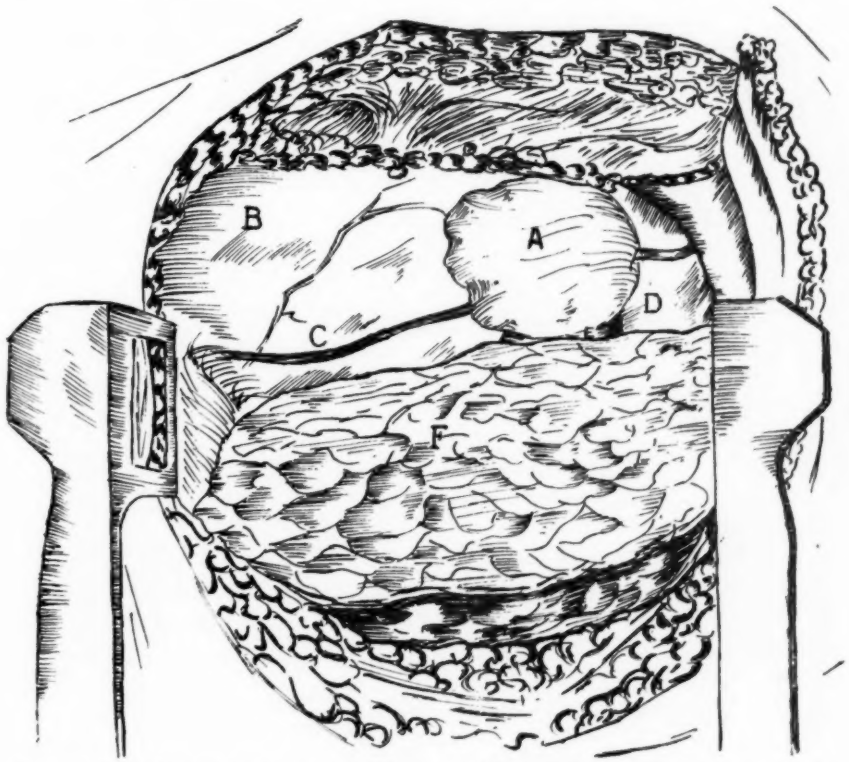


FIG. 2. Drawing of appearance of herniated left auricle at operation. A, left auricle; B, pericardium over left ventricle; C, phrenic nerve; D, aortic arch; E, left pulmonary artery; F, left lung.

arose. It was decided that inasmuch as the defect was probably congenital and the patient had not experienced symptoms because of it no repair of the pericardium was indicated. Recovery was unremarkable.

COMMENTS AND CONCLUSION

The abnormal hiatus through which the auricle herniated probably resulted from a failure of the pleuropericardial membrane to close completely the space between the pleura and pericardium in fetal life. The embryonic celom is partitioned by the pleuropericardial folds, the pleuroperitoneal folds and the septum transversum.[2] These folds arise from the dorsolateral mesoderm of the body wall of the embryo. The pleuropericardial folds grow cephalad and mesially to form the pleuropericardial membrane which fuses with the primitive mediastinum. The diaphragm is formed from the septum transversum and pleuroperitoneal membrane in a similar ingrowth toward the mid-axis of the body but its closure is somewhat later than that of the pericardium.

Failure of the pleuroperitoneal sinus to close results in a diaphragmatic hernia of the foramen of Bochdalek. Similarly, a failure of the pleuroperitoneal fold to complete its growth results in a defect of the pericardium. Arey[1] refers to such a developmental failure as "incomplete pericardium." Potter[3] in reference to this situation stated, "Abnormalities of the pericardium and pericardial cavity are uncommon except when other malformations affect the mediastinum. The pericardium is seldom partially or completely absent in any of our cases except in association with defects of the anterior body wall."

In the absence of any history or evidence of trauma the logical conclusion is that the herniation of the left auricle occurred through a small, congenital defect which resulted from failure of the pleuropericardial fold to close

completely. This conclusion is drawn notwithstanding the fact that no anomaly of the anterior body wall existed.

This case of hernia of the auricle through the pericardium, causing an abnormal roentgenogram, is unique in our experience and no reference to a similar case has been found.

REFERENCES

1. Arey, L. B. Development Anatomy. Philadelphia and London, 1949. W. B. Saunders Co.
2. Patten, B. M. Human Embryology. Philadelphia and Toronto, 1947. The Blakiston Co.
3. Potter, E. L. Pathology of the Fetus and Newborn. Chicago. The Year Book Publishers.

Very rarely is it indicated to do more than a simple closure in patients with an acutely perforated peptic ulcer. Operative results are excellent if the opening is sealed off within six to eight hours, mortality being only 4 per cent, whereas in patients operated upon later the mortality may be 20 per cent or more. Patients unsuitable for surgery suffered a 40 per cent mortality according to the studies of Burbank and Roe. Intravenous fluids and transfusions, improved anesthesia, gastric suction and chemotherapy have all contributed to reduce mortality in these cases as compared to years ago. (*Richard A. Leonardo, M.D.*)

COLLOID ADENOCARCINOMA OF THE FUNDUS OF THE BLADDER ARISING IN THE EPITHELIUM OF THE URACHAL CANAL*

CASE REPORT WITH SUMMARY OF THE LITERATURE

AUGUSTUS HARRIS, M.D. AND CHRISTIE E. MCLEOD, M.D.

Essex, Connecticut

THE intent of this article is to arouse the urologist to a greater awareness of the occurrence of urachal tumors, in the hope that earlier recognition of these growths may be realized. We wish, further, to point out the need for treating them in a different manner than other types of vesical neoplasms. A brief survey of the literature has been made.

INCIDENCE

Mostofi and Dean[11] recently reviewed approximately 5,000 bladder tumors in the Registry of the Armed Forces Institute of Pathology. Forty-four of these, or about 1 per cent, were primary glandular carcinomas. Fifteen, or about 0.3 per cent, were situated solely at the fundus. Peacock and Corbett reported an occurrence of only 0.5 per cent. Begg, in recording his own second case, summarized nineteen of these mucoid tumors up to the year 1936. He stated that this number did not represent the complete total, as he had received several personal communications of unpublished cases from medical confreres. Hayes and Segal summarized forty-five cases in 1945. Bandler and Roen,[2] in 1950, reported a successful operation for this type of tumor found in an elderly man. They estimated a total of fifty cases on record up to that time.

CLINICAL CONSIDERATIONS

The characteristic anatomic location of the mucoid tumors at the vertex, together with their typical structure, seem to mark them as being purely urachal in origin. The occurrence of the mucinous adenocarcinomas located elsewhere in the bladder, however, is more logically explained on the basis of metaplastic cell behavior, secondary to the various chronic inflammatory and irritative conditions. Begg's scholarly papers[3–5] on urachal adenocarcinoma are the most scientific and complete. They are recommended reading for all urologists and pathologists. The gross and microscopic anatomy and embryology are fully presented. Begg states that this is really not a bladder tumor at all, and that any attempt to treat it as such, by the usual methods of fulguration, radium, and x-ray is predestined to failure. Early recognition, however, does offer hope of effective cure by surgical means.

A review of recorded histories shows that the majority of these tumors were found in males, in the middle and later years of life. The average age was forty-six years and the youngest, twenty-six. Cystoscopic examination usually revealed either a lesion having the appearance of a flat ulcer or an opening which led into a blind canal resembling a pseudodiverticulum at the top or side of a papilla. Mucus was often observed in this area. Symptoms resembling cystitis, with the additional passage of mucoid material in the urine, were common.

It is stated that recurrence after removal is most likely to take place in the space between the peritoneum and transversalis fascia. In the past, 75 per cent are said to have died within two years after recognition. This fact strongly indicates the need of radical operation in all instances. Surgery should include removal of a large part of the bladder dome, the entire urachal cord, and a goodly flap of peritoneum and transversalis fascia, together with the umbilicus. This offers the best chance of clinical cure.

CASE REPORT

A thin, rather delicate seventy-two year old man consulted me (A. H.) in April, 1950, complaining of intermittent hematuria of nine months' duration. The condition was asso-

* From the Departments of Urology and Pathology, Middlesex Hospital, Middletown, Conn.

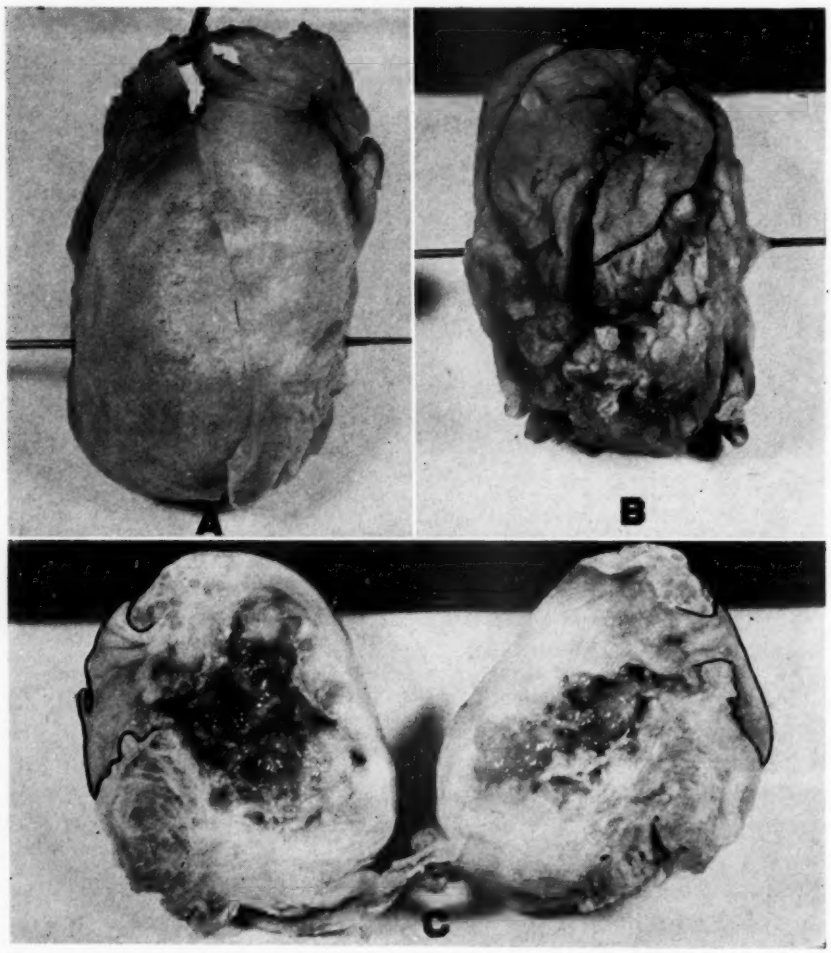


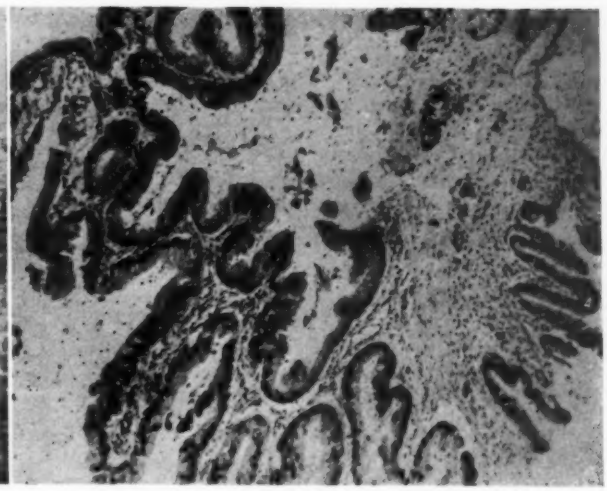
FIG. 1. Gross specimen. A, showing anterior surface and attached peritoneal reflection. B, showing bladder mucosal surface outlined in black. Round canal opening from tumor into bladder indicated by arrow. C, cut to show interior. Bladder opening and mucosa outlined in black. Note large amount of mucus present in tumor.

ciated with moderate dysuria and nocturia. There was no loss of body weight. Manual examination of the entire abdomen and suprapubic region was negative for any tumor. Cystoscopy revealed a small, flat, "granular" neoplasm about 1 cm. in diameter at the vertex of the bladder.

In view of the location, flatness and small size no attempt was made to obtain biopsy, and the area was fulgurated. Two subsequent fulguration treatments were followed by complete disappearance of the tumor, and with restoration of the bladder mucosa to its normal state. The bladder, thereafter, remained normal on cystoscopy performed every six months, until June, 1952, when the hematuria and dysuria recurred with passage of considerable mucus. A small 1 cm. crater-like ulcer covered with grayish mucus and surrounded with smooth, raised, velvety edges, was then manifest. Open operation was advised, but deferred by the patient because of disability from acute bursitis.

The patient was operated upon July 31, 1952, under spinal anesthesia. Wide exposure by transverse peritoneal incision revealed a smooth, firm, oval-shaped tumor (about hen's egg size) extending upward from the vertex of the bladder, having somewhat the contour of a diverticulum. A goodly portion of peritoneum was left attached to the bladder wall at the dome, and the remaining free peritoneum, above and below, was closed tightly. The mobilized, extraperitonized bladder was then incised on the lower anterior wall and the tumor mass was removed, together with an adequate portion of surrounding normal bladder, all the way around. At this time

2A



2B

2C

FIG. 2. Microscopically. A, showing normal transitional bladder epithelium at right, in contrast to tall columnar type of neoplastic epithelium at left. (No. 10 ocular × 4 mm. objective.) B, showing higher magnification of neoplastic epithelium. (No. 10 ocular × 16 mm. objective.) C, showing production of mucus by neoplastic epithelium. (No. 10 ocular × 16 mm. objective.)

the small opening in the mucosa at the fundus was seen to extend as a blind channel up into the center of the growth, from which lumpy, gelatinous, mucoid material could be extruded. The normal bladder wall was then closed tightly with two rows of sutures and an indwelling urethral catheter inserted. Healing by primary union followed. Convalescence was without incident and the patient was discharged on the seventeenth postoperative day.

He has fully recovered in weight and strength and now enjoys better health then he has had for some time. At this writing, over a year later, cystoscopy and abdominal examination show no evidence of recurrence.

Pathologic report: Grossly, the specimen consisted of a mass of soft tissue from the bladder wall, measuring 6 by 4 by 4 cm. The posterior and lateral surfaces of this mass were smooth and covered by serosa. At the apex of the specimen there was a peritoneal reflection measuring 1 cm. in width. The superior surface was covered by a layer of fascia. The inferior surface was lined by bladder mucosa which appeared edematous. There was an opening in the mucosa measuring 5 mm. in diameter leading into a mass in the wall measuring 2.5 cm. in diameter. This mass was made up of soft gelatinous-like tissue and was completely surrounded by a zone of normal tissue which measured 3 mm. at its narrowest point. (Fig. 1.)

Microscopically, the transitional epithelium along the mucosal surface showed no irregularity or invasion, but there was a break in the continuity of the epithelium beneath which there was a mass made up of well differentiated tall, columnar epithelium with gland formation and a large amount of mucinous substance. There were a few bizarre nuclei and mitoses.

Considerable infiltration of polynuclears, eosinophils and lymphocytes were present. This tissue appeared to be surrounded by a zone of normal tissue. Multiple sections taken from the soft tissue beneath the peritoneal reflection showed no neoplastic cells. (Fig. 2.)

Diagnosis was colloid adenocarcinoma of bladder Grade II.

This specimen showed numerous characteristics of a colloid adenocarcinoma of the fundus of the bladder, arising in the urachus, as described by Begg, namely, its location at the vertex of the bladder, with communication with the bladder cavity which is said to be present in 33 per cent of the cases. The opening is flush with the mucosa and extends into a pouch-like "diverticulum" containing mucoid material, and lined with high columnar cells with basal nuclei.

SUMMARY

A case of adenocarcinoma of the fundus of the bladder arising in the urachal canal is presented to remind the urologists of the occurrence of this type of tumor. The appearance of a single growth at the vertex should put the examiner on his guard as to the possibility of this mucoid neoplasm. Moreover, the attachment of thick mucus to the tumor site, and its presence in the urine should be noted as being strongly suggestive of the actual condition. Early diagnosis and radical operation are the prerequisites of successful treatment.

REFERENCES

1. Armstrong, C. P. and Harlin, C. H. Mucinous adenocarcinoma of the urinary bladder. *South. Surgeon*, 16: 297, 1950.
2. Bandler, C. G. and Roen, P. R. Mucinous adenocarcinoma arising in urachal cyst and involving bladder. *J. Urol.*, 64: 504, 1950.
3. Begg, R. C. The urachus: its anatomy, histology and development. *J. Anat.*, 64: 170, 1929–30.
4. Begg, R. C. The colloid adenocarcinomata of the bladder vault arising from the epithelium of the urachal canal. *Brit. J. Surg.*, 18: 422, 1931.
5. Begg, R. C. Colloid tumor of the urachus invading the bladder. *Brit. J. Surg.*, 23: 769, 1936.
6. Coppridge, W. M., Roberts, L. C. and Culp, D. A. Glandular tumors of the bladder. *J. Urol.*, 65: 540, 1951.
7. Emmett, J. L. and McDonald, J. R. Proliferation of glands of the urinary bladder simulating malignant neoplasm. *J. Urol.*, 48: 257, 1942.
8. Goyanna, R. and Emmett, J. L. Exstrophy of the bladder complicated by adenocarcinoma. *J. Urol.*, 65: 391, 1951.
9. Immergut, S. and Cottler, Z. R. Mucin-producing adenocarcinoma of the bladder associated with cystitis follicularis and glandularis. *Urol. & Cutan. Rev.*, 54: 531, 1950.
10. Lee, H. P. Colloid carcinoma of the bladder. *J. Iowa State M. Soc.*, 26: 246, 1936.
11. Mostofi, F. K. and Dean, A. L., Jr. Personal communication.
12. Patch, F. S. and Pritchard, J. E. Mucinous adenocarcinoma of the bladder. *Tr. Am. A. Genito-Urin. Surgeons*, 38: 213, 1946.
13. Patch, F. S. Epithelial metaplasia of the urinary tract. *J. A. M. A.*, 136: 824, 1948.
14. Pund, E. R., Yount, H. A. and Blumberg, J. M. Variations in morphology of urinary bladder epithelium. *J. Urol.*, 68: 242, 1952.
15. Spencer, H. Mucoid adenocarcinoma of the urinary bladder. *Brit. J. Surg.*, 29: 400, 1942.

REGRESSION OF INTRAEPITHELIAL CARCINOMA OF THE CERVIX FOLLOWING TUBAL ABORTION*

DAVID KUPERSTEIN, M.D., SAMUEL B. SCHENCK, M.D. AND ABRAHAM MACKLES, M.D.
Brooklyn, New York

THAT intraepithelial carcinoma of the cervix or of a histologic lesion indistinguishable from it can regress following the termination of intrauterine pregnancy has been demonstrated. The following is the first report, to our knowledge, in which such reversibility (real or apparent) has occurred after the termination of tubal pregnancy.

CASE REPORT

A. S. F., a twenty-three year old Negress, gravida II, para 0, was admitted to the Jewish Hospital of Brooklyn on the service of one of us (S. B. S.) on February 13, 1950. Admission complaints consisted of severe right lower quadrant pain and vaginal staining following a period of amenorrhea.

Left salpingo-oophorectomy for tubal pregnancy had been performed three years previously.

Menarche occurred at twelve and thereafter was of twenty-eight-day type and five-day habit. Last normal menstrual period began on November 10, 1949. Menstruation occurred on December 3rd but lasted only three days and the flow was scanty. Amenorrhea was present until the day of admission. On February 13, 1950, at noon, severe right lower quadrant pain was noted; the pain disappeared and returned late that afternoon, persisting until admission several hours later. The pain was limited to the right lower quadrant and increased in severity. There was no nausea, vomiting, dysuria, dyschizia or fainting.

On admission the patient's temperature was 99°F., pulse rate 88, respiratory rate 24 and blood pressure 130/90. Examination of the blood showed a hemoglobin of 67 per cent, a red blood cell count of 3,460,000 and a white cell count of 12,150; Rh was positive, group B. Urinalysis was negative. Sedimentation rate was 65 mm. in thirty seconds. Ascheim-Zondek test was subsequently reported as positive.

Abdominal examination revealed generalized tenderness in the lower half, most marked in the right lower quadrant, and generalized rebound tenderness in the lower half of the abdomen. On pelvic examination the introitus was of marital type. The cervix was firm, nodular and not tender. The uterus was anteverted and regularly enlarged to the size of six weeks' gestation; it felt slightly softer than normal and was not tender. A cystic, tender mass was palpable in the right fornix and posterior cul-de-sac. The left fornix was clear.

Speculum examination revealed an eroded cervix which bled very easily on touch and a Papanicolaou smear was taken from it. The smear, as interpreted by one of us (A. M.), consisted of many leukocytes, red blood cells and squamous cells. Many of the latter had large, irregular, hyperchromatic nuclei. Some irregular nuclei were vesicular with irregularly distributed chromatin. These cells were apparently malignant and cervical biopsy was advised.

Biopsy was delayed for one week because of the uncooperative attitude on the part of the patient. Prior to biopsy, a decidual cast, histologically confirmed, was passed spontaneously. (Fig. 1.) Biopsy consisted of the excision of the entire squamo-columnar junction with a sharp scalpel. The report of microscopic examination by Dr. David M. Grayzel was as follows: Preparations from the anterior lip consisted chiefly of orderly endocervical glands and stroma. In one section a superficially placed layer of squamous epithelium was noted and here there was a slight increase in the thickness of the basal layer. Just on the squamous side of the squamo-columnar junction the epithelial cells were more numerous, closely crowded and contained large deeply staining nuclei, some of which were in mitotic division. The epithelial changes in the preparations from the posterior lip were even more

* From the Departments of Gynecology and Pathology, Jewish Hospital of Brooklyn, Brooklyn, N. Y.

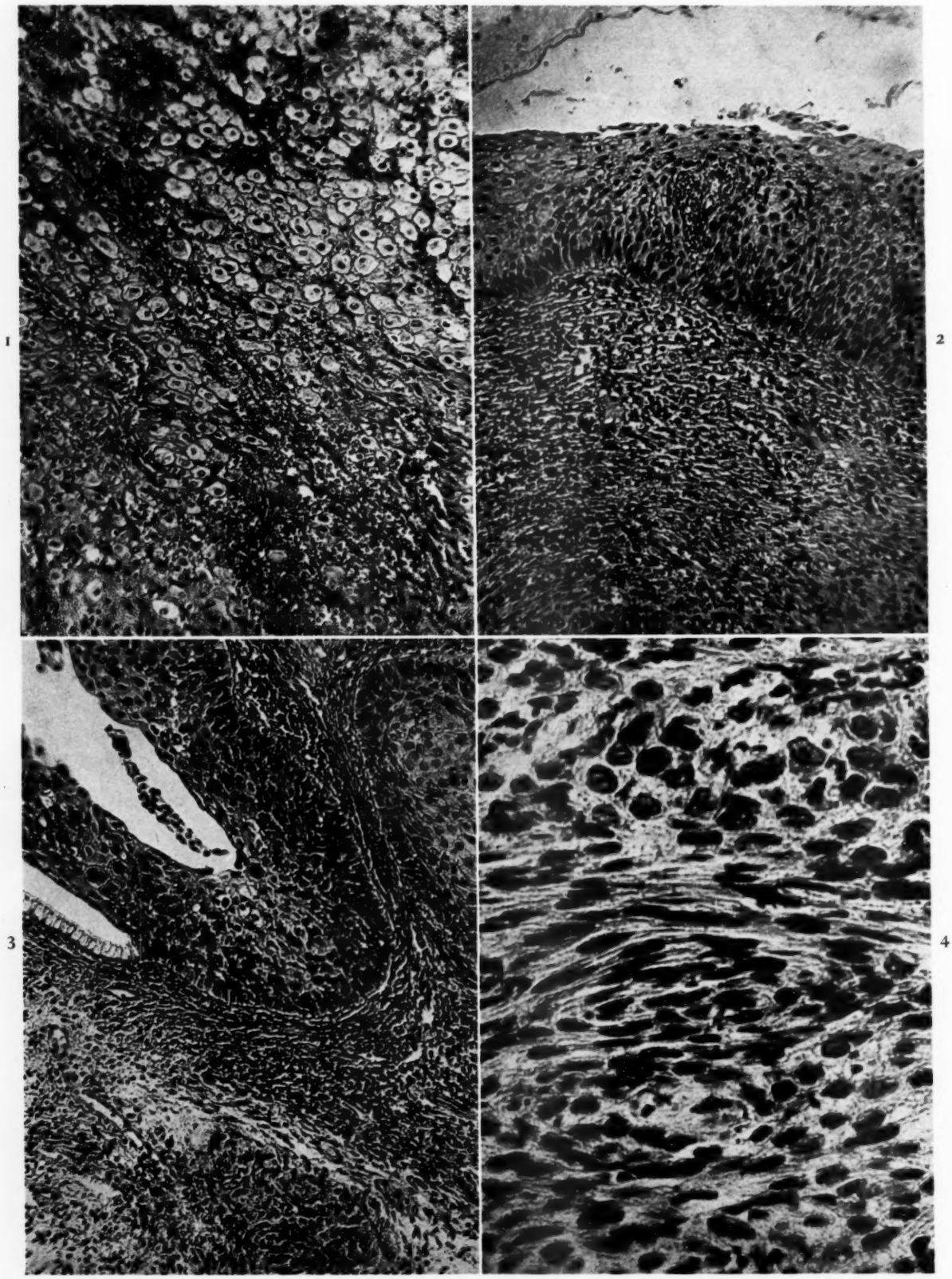


FIG. 1. Decidual tissue passed in form of cast. × 300. FIG. 2. Junction of normal ectocervical mucosa and intraepithelial malignancy. × 300. FIG. 3. Extension of malignant epithelium into endocervical gland. × 300. FIG. 4. High power view of portion of malignant epithelium; note elongated "fiber" cells. × 600.

striking and many of the epithelial cells were multinucleated. In addition, several endocervical glands were completely or partly filled with cells similar to those comprising the surface layer. Inflammatory cells were present beneath the surface epithelium and about the glands. Diagnosis revealed portions of cervix uteri, with intraepithelial squamous cell carcinoma extending into the endocervical glands. (Figs. 2 to 4.)

Because of the uncooperative attitude of the patient, laparotomy was delayed until two weeks after cervical biopsy. The area of cervical biopsy was well healed by then. At operation a mass about 7 cm. in diameter, bound to the posterior leaf of the right broad ligament by many fine adhesions, was found. The mass was subsequently shown to consist of the distal end of the tube with degenerated placental tissue and blood clot. The tube was unruptured. A degenerated fetus, 5 cm. long, was found lying free in the peritoneal cavity. The right ovary was involved in the mass and adhesions. The left tube and ovary were absent and the uterus was slightly enlarged.

The adhesions surrounding the mass were freed bluntly and the uterus and mass were delivered. The mass was excised by clamping the pedicle and was removed. The fetus was also removed. Total hysterectomy and salpingectomy was then performed in the usual manner. During the operation the patient received 1,000 cc. of normal saline and 500 cc. of whole blood.

Pertinent pathologic findings were as follows: grossly the body of the uterus showed little of note. An area of laceration 4 mm. in greatest dimension was present near the external cervical os. The squamo-columnar junction was otherwise smooth. The endocervical mucosa was smooth, yellow and thrown up into the usual folds. The distal half of the tube was distended to 1 cm. in diameter and the outer surface was roughened by fibrous tags. The lumen of the distal portion was filled with clotted blood and spongy placental tissue. A macerated fetus, 5 cm. long, with 3 cm. of attached umbilical cord was also received.

Microscopically, the tube contained numerous degenerated chorionic villi. The endometrium was of the regenerative type. Five blocks were taken from the cervix and twenty-five sections made of the cervix. No areas suggestive of carcinoma were found. In one of the preparations a moderate degree of basal cell hyperactivity was present.

Diagnosis: uterus with regenerative endometrium; cervix uterus with chronic and acute cervicitis and with nabothian cysts and basal cell hyperactivity; right fallopian tube with degenerated placental tissue; degenerated fetus, 5 cm. long.

The patient was allowed out of bed the day after the operation. Five days later clips were removed from the skin and the wound had healed by primary union. On the tenth day, at discharge, examination revealed the abdominal wound to be well healed; the vaginal vault was clean, held high and healing. No induration, masses or tenderness were palpable. Examination four months later in the outpatient department revealed healing of the vaginal vault. The patient was asymptomatic. Upon recent examination no abnormalities were noted and the patient is symptom-free. Vaginal smears have been negative.

COMMENT

The interval between cervical biopsy and hysterectomy was two weeks. Cervical biopsy was taken one day after a decidual cast was passed and, therefore, presumably, one day after the death of the fetus. When hysterectomy was performed, the intraepithelial carcinoma could not be detected on histologic study of the excised cervix. When the excised cervix was originally studied, it was believed that the failure to demonstrate the carcinoma resulted from either its entire removal during biopsy or failure to study the organ by the serial section method. With the passage of time and the demonstration that intraepithelial carcinoma diagnosed during pregnancy sometimes regresses following labor it is now believed that in this instance the carcinoma regressed following the death of the fetus.

SUMMARY

Concomitant carcinoma *in situ* of the cervix and tubal pregnancy in a twenty-three year old Negress are reported. Two weeks after the death of the fetus apparent regression of the carcinoma *in situ* had occurred.

REFERENCES

1. Carrow, L. A. and Greene, R. R. The epithelia of the pregnant cervix. *Am. J. Obst. & Gynec.*, 61: 237–252, 1951.
2. Danforth, W. C. Carcinoma of the cervix during

pregnancy. *Am. J. Obst. & Gynec.*, 34: 365–379, 1937.

3. Glatthaar, E. C. Superficial carcinoma of the cervix uteri. *Am. J. Obst. & Gynec. (supp.)*, 61A: 73–82, 1951.
4. Greenhill, J. P. Carcinoma of the cervix in pregnancy. *S. Clin. North America*, pp. 181–183, 1950.
5. Hellman, L. M. and Nesbitt, R. E., Jr. The histopathology and cytology of the cervix in pregnancy. *Surg., Gynec. & Obst.*, 94: 10–20, 1952.
6. Herig, A. T. and Younge, P. A. What is cancer in situ of the cervix? *Am. J. Obst. & Gynec.*, 64: 807–815, 1952.
7. Hunt, A. B. and Mussey, R. D. Cancer of the cervix in pregnancy. In: Meigs and Sturgis. Progress in Gynecology, vol. 2, pp. 622–629. New York, 1950. Grune & Stratton.
8. Kobak, A. J., Fitzgerald, J. E., Freda, V. C. and Rudolph, L. Carcinoma of the cervix and pregnancy. *Am. J. Obst. & Gynec.*, 49: 307–326, 1945.
9. Maino, C. R. and Mussey, R. D. Carcinoma of the cervix coincident with pregnancy. *Am. J. Obst. & Gynec.*, 47: 229–244, 1944.
10. McKelvey, J. L. Carcinoma in situ of the cervix. *Am. J. Obst. & Gynec.*, 64: 816–832, 1952.
11. Mussey, R. D. Cancer of the cervix in pregnancy. In: Meigs and Sturgis. Progress in Gynecology, vol. 1, pp. 410–416. New York, 1946. Grune & Stratton.
12. Nolan, J. J. and Pollak, O. H. The ectocervix during gestation. *Surg., Gynec. & Obst.*, 93: 609–615, 1951.
13. Sadugor, M. G., Palmer, J. P. and Reinhard, M. C. Carcinoma of the cervix concomitant with pregnancy. *Am. J. Obst. & Gynec.*, 57: 933–938, 1949.
14. Williams, J. T. Cancer of the cervix complicating pregnancy. *Boston M. & S. J.*, 160: 669–676, 1909.
15. Willson, J. R. Carcinoma of the cervix complicated by pregnancy. *Am. J. Obst. & Gynec.*, 50: 275–283, 1945.

PERSISTENT OMPHALOMESENTERIC DUCT WITH OMPHALOCELE

JOHN H. GRATIOT, M.D.
Monterey, California

THE finding of an omphalocele at birth is indeed disconcerting. This unusual finding can be handled effectively in most cases if the embryologic and anatomic situation is fully understood and if prompt treatment is instituted. This is not a common condition; it has been estimated that it occurs once in every five or six thousand births and that males are involved about twice as often as females (Specht and Shyrock).

The first case was reported in 1634 (Specht and Shyrock) and four to five hundred have been reported since then. My reason for reporting this case is not merely the finding of an omphalocele, but also that, with the accompanying anatomic findings, I am unable to find a comparable case in the literature. This case consisted of an omphalocele with a Meckel's diverticulum, or omphalomesenteric duct, the end of which was implanted in the side of the sac, opening as a fistula. Also the omphalomesenteric duct acted as a fulcrum, obstructing the ileum proximal to it.

CASE REPORT

Female baby K. J. E. was born at term January 19, 1950. She seemed to be in good general condition, responding well, breathing and crying normally. Birth weight was 5 pounds, 7 ounces.

Examination at birth showed the presence of a typical thin-walled, semi-transparent omphalocele sac, about 8 cm. in diameter at its base, extending about 10 cm. above the level of the abdominal wall. (Fig. 1.) When the baby strained or cried, the sac became distended with loops of small intestine. Most of these loops could be reduced into the abdominal cavity without much difficulty. Near the apex of the sac, on its right side, red everted intestinal mucosa was present, grown firmly to the sac. This mucosa was in the form of a ring, approximately 2 cm. in diameter. Through this ring a small amount of greenish meconium could be expressed. Rectal examination was normal.

It was believed that this represented an omphalocele with an external intestinal fistula and that it was not unlikely that there was an obstruction below the point of the fistula. Immediate exploration was deemed advisable, to restore the intestinal tract to normal, to prevent dehydration and particularly to prevent infection of the omphalocele, with ensuing peritonitis.

A circular incision was made through the skin surrounding the base of the omphalocele sac, a small cuff being removed so as to freshen the edges. The fascia was incised in the line of the skin incision, as was the peritoneum. The umbilical arteries and vein were ligated. The omphalocele sac was divided toward the apex, the incision surrounding the fistula. It was then apparent that the fistula was in the apex of a very short (1.5 cm.) Meckel's diverticulum, the everted mucous membrane being densely grown to the omphalocele sac. This diverticulum was 10 cm. proximal to the ileocecal valve. The ileum proximal to the diverticulum was of about normal calibre, that distal completely collapsed. The proximal intestine was not dilated, of course, because of the external fistula. The ileum just distal to Meckel's diverticulum was obstructed by being twisted and angulated, the diverticulum being a fixed point.

After correcting this angulation a probe could readily be inserted down through Meckel's diverticulum, through the ileum, and through the ileocecal valve.

The everted mucous membrane of the fistula and the diverticulum were excised. The ileum was closed transversely with a continuous Connell suture of No. 0000 chromic catgut, reinforced with interrupted mattress sutures of No. 0000 silk.

Thus the omphalocele sac was excised, the fistula closed, the Meckel's diverticulum removed and the obstruction relieved. The intestines were placed into the abdominal cavity,

1

2

FIG. 1. Preoperative photograph showing the omphalocele and cord. Notice the dark area near the base of the cord which is everted mucosa of the omphalomesenteric duct, or Meckel's diverticulum, implanted in the wall of the omphalocele. This is an external fistula.

FIG. 2. This is the patient at age three. She has had perfectly normal development.

the peritoneum closed with continuous No. 00000 cotton, the fascia and skin with interrupted No. 00000 cotton. Pathologic examination of the sac and diverticulum was unremarkable.

Postoperatively the baby was given oxygen, penicillin, glucose orally, followed by gradually increasing formula. During the first week there was an occasional regurgitation of a small portion of the feedings; however, most was retained. The first bowel movement was thirty-six hours after surgery. Recovery was entirely uneventful.

The baby was discharged from the hospital on the sixteenth postoperative day, weighing 4 ounces more than at birth.

This baby has had a completely normal physical and mental development up to the present time. She is now just over three years old (Fig. 2) and weighs 39 pounds. Her appetite is good; her bowel movements normal.

The *development* of the intestinal tract in early fetal life presents a fascinating story. The fore- and hind-gut are first seen at about three or four weeks; the intestine presenting as a simple tube with a spindle-shaped stomach. Ventral to the mid-gut the vitelline duct, or yolk stalk extends into the umbilical cord. At five weeks the intestine has elongated into a loop and by seven weeks (17 mm.) this has progressed out into the umbilical cord (a "physiologic herniation"). The intestine continues to elongate and to coil, and at ten to eleven weeks (40 mm.) is withdrawn into the abdomen.

This is a simple chronologic saga of early intestinal progress. The reason for these events is a somewhat controversial subject.

With the relatively rapid growth of the intestine and liver (five to ten weeks) compared to that of the abdominal cavity it is necessary that an "accessory abdominal cavity" temporarily hold the intestines until the abdominal cavity can "catch up" in growth.

As the abdominal parieties grow more rapidly, the intestines are drawn back into the abdominal cavity, the cephalic portion of the intestine returning first. The caudal intestine returns finally at about the eleventh week.

The factors causing withdrawal into the abdominal cavity may be one or more of the following (Specht and Shyrock): (1) negative intra-abdominal pressure produced by a relative retardation in the rate of growth of the liver; (2) positive extra-abdominal pressure; (3) traction exerted by the mesentery because of a relative retardation in its rate of growth; (4) tension exerted by the non-herniated portions of the gut; (5) pressure exerted against the inferior portion of the hernia because of enlargement of the umbilical arteries.

In addition to the intestinal protrusion into and withdrawal from the cord, there is rotation, both while the intestine occupies its extra-

abdominal position as well as after its withdrawal into the abdomen. This rotation is extremely interesting but not entirely pertinent to the present discussion. The three stages of rotation are well described in Dott's article, and need not be reproduced here.

Nothing is to be gained by a listing of the numerous suggested causes of omphalocele. The *etiology* certainly has to do with disproportion between the size of the abdominal cavity and its contents. It can be explained either by failure of withdrawal of intestines into the abdomen, or by comparative retardation of growth of abdominal parieties, particularly in the supra-umbilical region.

The *diagnosis* of omphalocele is obvious at birth. It cannot be confused with umbilical hernia, which is covered by skin. Only an omphalocele has a thin transparent membrane covering it. If an external intestinal fistula is seen protruding from the omphalocele (as in the case being reported, but an extremely rare finding), it is embryologically almost certain that this must be a patent omphalomesenteric duct or Meckle's diverticulum, the remnant of the yolk stalk. Persistence of the omphalomesenteric duct without omphalocele has been reported in about 150 cases. Failure of obliteration of various sections of the omphalomesenteric duct leads to different clinical findings. If the distal portion is obliterated, but the proximal remains patent, a Meckel's diverticulum results. If the mid-portion alone is patent, a mucous-secreting cyst will be found beneath the umbilicus. Patency of only the distal part will result in a blind secreting intestinal loop opening at the umbilicus. If none of the duct is obliterated, as in the case presented here, an external intestinal fistula results.

Anatomically an omphalocele consists of a transparent membrane consisting of an outer amniotic and inner peritoneal layer. This is moist and soft at birth, but rapidly dries out, becomes stiff and "crinkly"; portions gradually become necrotic. Infection and perforation ensue.

Surrounding the base of the sac are all the layers of the abdominal wall: skin, subcutaneous tissue, anterior rectus fascia, rectus muscle, posterior rectus fascia and peritoneum. The peritoneum, rectus muscle and anterior rectus fascia may be sutured as separate layers.

Contents of the sac vary. The small intestine is usually present; various portions of the liver are present in half of the cases. Other viscera which have been seen are the pancreas, Meckel's diverticulum, part of urinary bladder, uterine tube and spleen (Gross and Blodgett).

Treatment of omphalocele is entirely surgical. So-called conservative treatment will result in death. The sac will dry, become necrotic, perforate. Peritonitis inevitably ensues. Surgery should be undertaken as soon after birth as is practical.

I prefer a light general anesthesia, but local could be used. The sac with a very small cuff of skin is excised. Hemostasis is obtained; the hypogastric arteries and umbilical vein are igated separately. The abdominal layers are exposed and sutured, after replacement of the abdominal contents. The peritoneum, rectus muscle, anterior rectus fascia, and skin may be separately sutured. Fine catgut, cotton, or silk may be used.

If the abdominal cavity is too small to hold the organs which are in the sac, forceful replacement with tight closure of the abdomen is dangerous. One or more of three serious conditions may result (Gross and Blodgett): (1) respiratory embarrassment, cyanosis, etc., caused by upward displacement of the diaphragm; (2) edema of the legs or circulatory collapse due to pressure on the inferior vena cava; (3) intestinal or gastric obstruction due to pressure.

If the abdominal parieties cannot be approximated in layers without tension, only those layers which can be brought together should be sutured. This may consist of the anterior rectus fascia and skin, or of the skin alone. A secondary repair of the abdominal wall may be done at the elective time after enlargement of the abdominal cavity.

If the omphalocele sac is adherent to the liver, separation might bring about considerable hemorrhage. In such a case it is better to leave a portion of the sac attached, and to insert it into the abdominal cavity.

SUMMARY

The subject of persistent omphalomesenteric duct with omphalocele is reviewed; a unique case of this combination is described.

REFERENCES

Adams, F. H. Omphalocele. *J. Pediat.*, 32: 304–308, 1948.

BENSON, C. D., PENBERTHY, G. C., and HILL, E. J. Hernia into umbilical cord and omphalocele in newborn. *Arch. Surg.*, 58: 833–847, 1949.

BIRD, W. E. Littre's hernia of Meckel's diverticulum. *Am. J. Surg.*, 60: 81–87, 1943; *Delaware State M. J.*, 15: 51–57, 1943.

BRONAUGH, W. Omphalocele. Herniation and exstrophy of ileum in newborn incidental to adherent Meckel's diverticulum in umbilical area. *West Virginia M. J.*, 43: 126–129, 1947.

BROWN, A. G. and CAIN, F. G. Evagination of ileum through patent omphalomesenteric duct. *Am. J. Surg.*, 79: 339–340, 1950.

BRYAN, T. B. L. Exomphalos: Complicated by acute intestinal obstruction. *Brit. M. J.*, 2: 818–819, 1944.

CUTLER, G. C. Prolapsus of the bowel through a patent omphalo-mesenteric duct opening on the side of the umbilical cord. *Boston M. & S. J.*, 19: 782, 1924.

DOTT, N. M. Case of exomphalos. *Tr. Edinburgh Obst. Soc.*, pp. 105–108, 1932.

DOUGLASS, L. P. and CUSHMAN, G. F. Surgical management of ruptured omphalocele. *California Med.*, 74: 131–133, 1951.

EAST, J. A. Exomphalos. *J. Internat. Coll. Surgeons*, 9: 426–431, 1946.

FERGUSON, J. A. Omphalocele. Persistent omphalomesenteric duct and Meckel's diverticulum; 68 cases. *Univ. Hosp. Bull., Ann Arbor*, 14: 47–52, 1948.

FOX, P. F. and BRENNAN, J. E. Ruptured omphalocele and jejunal atresia. *Ann. Surg.*, 133: 123–126, 1951.

GLOVER, H. M. Exomphalos. *J. Kansas M. Soc.*, 38: 89–93, 1937.

GORDON, J. W. Congenital omphalocele. *J. Michigan M. Soc.*, 31: 533–535, 1932.

GROSS, R. E. New method for surgical treatment of large omphaloceles. *Surgery*, 24: 277–292, 1948.

GROSS, R. E. and BLODGETT, J. B. Omphalocele in newborn. *Surg., Gynec. & Obst.*, 71: 520–527, 1940.

HAINES, C. E. and MCILROY, P. T. Newborn baby with massive hernia. *Am. J. Surg.*, 21: 297–298, 1933.

HENDTLASS, R. F. Extreme exomphalos. *Brit. M. J.*, 1: 477, 1943.

HOLLENBERG, H. G. Amniotic hernia. *Surgery*, 23: 363–368, 1948.

HORWITZ, A. Exomphalos. *Ann. Surg.*, 92: 454–456, 1930.

HUNTER, W. Exomphalos simulating placenta praevia. *Brit. Med. J.*, 1: 1–6, 1939.

KERSHNER, D., ZUCKERMAN, I. C., and KESSLER, N. L., Omphalocele. *J. Internat. Coll. Surgeons*, 11: 89–95, 1948.

KITTLE, C. F. JENKINS, H. B., and DRAGSTEDT, L. R., Omphalocele. Patent omphalomesenteric duct. Relation to diverticulum of Meckel. *Arch. Surg.*, 54: 10–36, 1947.

KORSHET, M. Hernia into umbilical cord with spontaneous rupture at birth. *California & West. Med.*, 51: 392–393, 1939.

LEY, L. Exomphalos: Successfully treated by operation. *Brit. J. Surg.*, 30: 168–169, 1942.

MAGUIRE, C. H. Surgical management of omphalocele. *Arch. Surg.*, 59: 484, 1949.

MARGUILES, L. Exomphalos. Anatomy and etiology in relation to umbilical hernias. *Am. J. Obst. & Gynec.*, 49: 695–699, 1945.

MORENO, I. G. Umbilical prolapse of Meckel's diverticulum. Case of newborn infant, *Arch. argent. de enferm. d. ap. digest. y de la nutrición*, 17: 72–76, 1941.

MORGAN, J. E. Patent omphalomesenteric duct. Review of literature. *Am. J. Surg.*, 58: 267, 1942.

MORRISON, H. J. and NEVILLE, R. L., Omphalocele with congenital obstruction. Case with Meckel's diverticulum. *Am. J. Dis. Child.*, 65: 781–784, 1943.

PEIKOFF, S. S. Exomphalos. *Canad. M. A. J.*, 52: 600–602, 1945.

ROGERS, L. Exomphalos: radical cure in infant twenty minutes old. *Brit. J. Surg.*, 29: 37–38, 1941.

ROWE, O. W., PEDERSON, R. C., and WELLS, A. H. Omphalocele. *Minnesota Med.*, 31: 506–509, 1948.

SEARLE, G. J., JR. and INGMORE, J. Amniotic hernia containing entire liver, gall bladder and large and small intestines. *Ohio State M. J.*, 37: 551–553, 1941.

SPECHT, N. W. and SHYROCK, E. H., Omphalocele: anatomical and clinical considerations. *Surg., Gynec. & Obst.*, 77: 319–325, 1943.

STANTON, N. B. Congenital hernia; three cases. *Am. J. Surg.*, 44: 646–648, 1939.

STEIN, J. L. and GERBER, A. Congenital omphalocele: four cases. *J. Pediat.*, 14: 89–91, 1939.

THUNIG, L. A. Hernia into umbilical cord and related anomalies. *Arch. Surg.*, 33: 102–105, 1936.

WELCH, K. J. Use of homograft in surgical treatment of large omphaloceles. *Surgery*, 29: 100–104, 1951.

FREE FISH BONE IN HERNIA SAC*

ALEX. E. PEARCE, M.D., THOMAS J. ZAYDON, M.D. AND EDWARD W. CONWAY, M.D.
Philadelphia, Pennsylvania

THE following case is reported because a fish bone was found free in a massively inflamed hernia sac without any evidence of adherence or perforation of the intestine and because the hernia sac was so thickened it looked like a uterus.

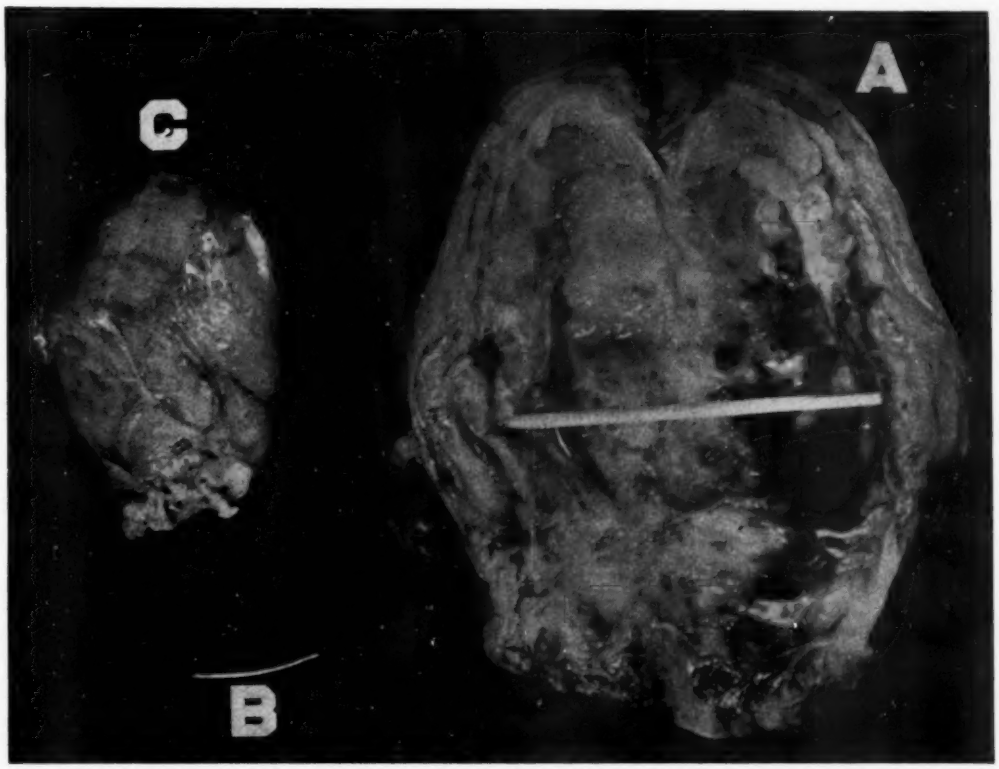


FIG. 1. A, hernia sac (edges held apart by matchstick); B, fish bone; C, testis and epididymis.

CASE REPORT

J. T., a white man, aged sixty-two, was admitted to Hahnemann Hospital (No. 53715) on March 31, 1951, with a chief complaint of pain and swelling in his right groin and scrotum. Three weeks before, vague hypogastric pain had developed within twenty-four hours after a fish dinner. He stated that he had not eaten fish for more than twenty years prior to this one occasion. The pain gradually subsided. Two weeks later, pain recurred with greater severity; it radiated into the scrotum and was made worse by movement and the application of a truss which he had worn on a right inguinal hernia for twenty-six years. Physical examination showed an edentulous mouth and an indurated tender mass occupying the entire right inguinal canal and scrotum. The testicle appeared to be moderately enlarged. The inguinal mass was not reducible; the patient stated that it had been reducible until the initial attack of pain. A provisional diagnosis was made of irreducible hernia with possibly an associated testicular tumor. White blood count was 11,400 with 65 per cent polynuclear cells. Chest x-ray was negative.

On April 3rd operation was carried out. A right inguinal incision was made exposing a markedly indurated, thickened, grayish white, indirect hernia sac which measured 13 cm. in length and extended into the scrotum. (Fig. 1A.)

* From the Division of Surgery, Hahnemann Medical College and Hospital, Philadelphia, Pa.

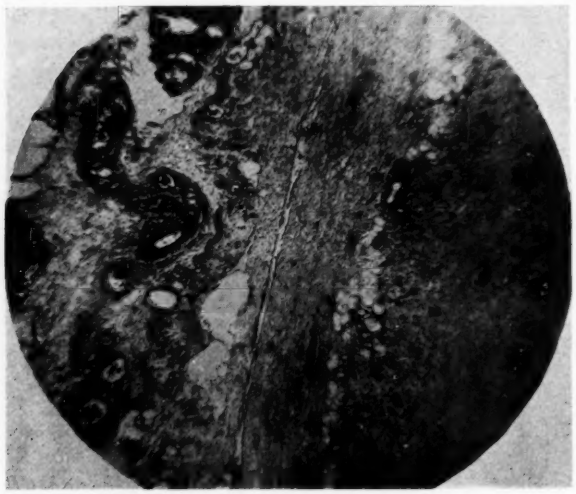


FIG. 2. Microscopic section of hernia sac showing chronic inflammation.

The sac was 3 cm. in its greatest thickness. No intra-abdominal contents were present in the sac. A fish bone measuring 3 cm. in length and 1 mm. in diameter was found free in the bottom of the sac. (Fig. 1B.) The testicle appeared to be normal except for a large amount of edema of the overlying areolar tissue. (Fig. 1C.) Orchidectomy and inguinal hernia repair with steel wire were then performed. Microscopic examination of the hernia sac and its coverings demonstrated intense chronic inflammation. (Fig. 2.) The testis and epididymis were normal. The fish bone was sectioned and microscopic examination demonstrated osseous structure. (Fig. 3.) The patient's convalescence was uneventful and he was discharged on April 10th. Follow-up examinations to eighteen months demonstrated no disability or recurrence.

COMMENTS

This case is unusual in that it demonstrates that a fish bone was ingested by the patient at a specific time and that this foreign object passed through the intestinal tract and then perforated the gut and lodged free in the lumen of a hernia sac without any evidence of adherence of the intestine or of localized suppuration. Approximately 100 instances of foreign body perforations complicating hernia have been reported since the first example recorded by Claudius in 1735. However, all of these have been associated with peritonitis, hemorrhage, obstruction, gangrene, abscess or fistula. We are able to date the time of ingestion of the fish bone because this man had eaten fish only once in more than twenty years. Apparently the perforation occurred twenty-four hours after ingestion when the vague lower abdominal pain developed. The recurrence of pain at a later date probably represented the development of a marked local reaction of the hernia sac itself to the foreign body. One would suppose that a knuckle of ileum probably lodged in the hernia sac and that the fish bone perforated the gut at a point of angulation in the hernia sac. It is possible that the fish bone may have perforated some small intestine in the free peritoneal cavity and then gravitated into the hernia sac itself.

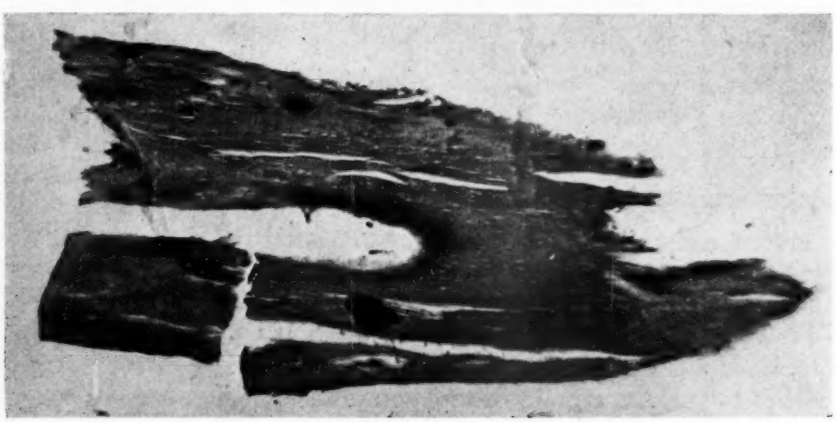


FIG. 3. Microscopic section of fish bone.

New Instruments

DRAINAGE OF THE COMMON BILE DUCT

USE OF A BALLOON RECEPTACLE

CHARLES CYRUS ABBOTT, M.D.

Jersey City, New Jersey

DRAINAGE of the common bile duct is used rather commonly in operations for the relief of obstruction both in operations concerned with plastic duct repair and in obstructed jaundiced cases postoperatively.

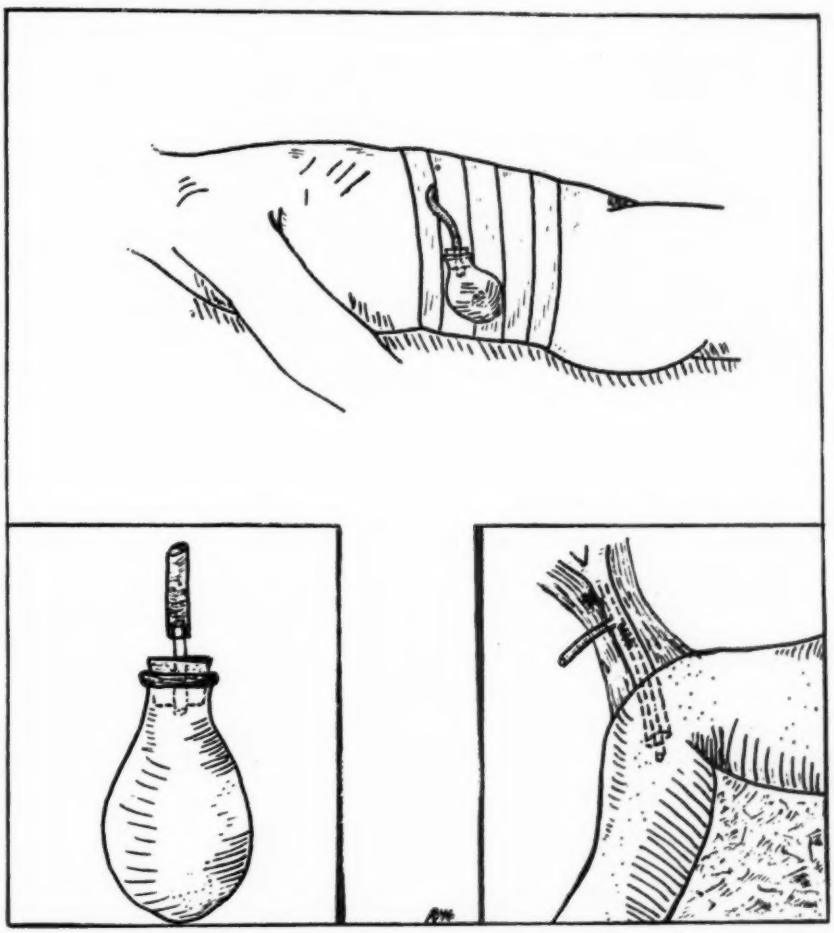


FIG. 1.

The chief indications for the exploration of the common bile duct are: (1) palpable common duct stones, (2) dilated common cystic or hepatic duct, (3) contracted gallbladder with stones, (4) thickened common duct, (5) jaundice associated with colic or stones and (6) sediment in the bile after needle aspiration of the common duct.

After exploration of the common duct there are differences of opinion as to how the duct should be handled. However, operative cholan-

giography cannot be too highly recommended. In fact it should be used wherever feasible in order to complete the search for hidden, non-visualized stones. Following this procedure we have the alternative of either closing the duct without duct drainage, as proposed by some surgeons, or T-tube drainage of the common duct, of which Lahey is one of the leading proponents. It is in this latter group where prolonged drainage may be necessitated that a balloon receptacle for the biliary drainage may make the patient much more comfortable. The use of the balloon receptacle is illustrated in Figure 1.

In conclusion it must be stated that T-tube drainage should be continued until liver function has improved, cholangiogram is normal and one is reasonably sure there is no stone nor stricture.

REFERENCES

BAUER, W. B. Postcholecystectomy complications due to incomplete removal of gallbladder and cystic duct. *Arch. Surg.*, 63: 612–616, 1951.

GLENN, F. Common duct exploration for stones. *Surg., Gynec. & Obst.*, 95: 431–438, 1952.

LAHEY, F. H. and PYRTEK, L. J. Surgical Practice of the Lahey Clinic. Experience with the operative management of 280 strictures of the bile ducts, pp. 488–530. Philadelphia, 1951. W. B. Saunders Company.

REINHOFF, W. F., JR. The surgical treatment of cholelithiasis. *Ann. Surg.*, 131: 994–998, 1950.

RADIOLOGISTS have produced five-year cures in the majority of cases of cancer of the uterine cervix treated recently, due mostly to earlier diagnosis and intensive radiotherapy. In early cases skilled gynecologists obtain very satisfactory results after radical surgery; however, the average surgeon will probably be wiser to resort to competent radiotherapy and a few follow this up with pelvic lymphadenectomy. Surgery is especially indicated in cervical cancer if the growth is not radiosensitive or if it has recurred after intense radiotherapy. (*Richard A. Leonardo, M.D.*)

A NEW PROCTOSIGMOIDOSCOPIC CRADLE AND COMBINATION EXAMINING TABLE

CHARLES W. McCLURE, M.D. AND TIMOTHY A. LAMPHIER, M.D.
Boston, Massachusetts

THIS report describes two newly developed apparatus. One is an entirely originally devised sigmoidoscopic cradle for placing the patient comfortably in the knee-chest position. The other is a simple and eminently practical combination examining table. This table not only carries the originally designed sigmoidoscopic cradle but also is easily and rapidly convertible for the usual physical, gynecologic and genitourinary examinations. Clinical experience with these apparatus proved them to be so useful that it was decided to make them available to the medical profession.

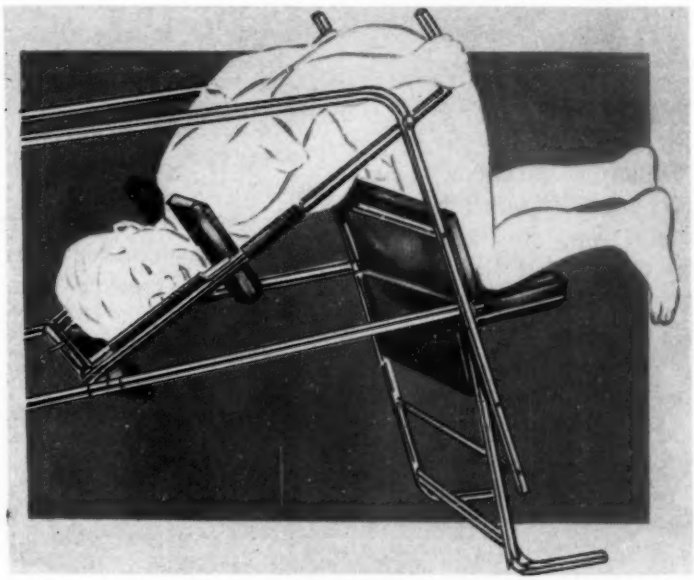


FIG. 1. Proctosigmoidoscopic cradle.

Recognition of the fact that about 70 to 80 per cent of all large bowel malignancies originate within the range of the 25 cm. proctosigmoidoscope has caused progressively more frequent examinations of the rectum and rectosigmoid. For this reason sigmoidoscopy, a procedure formerly performed largely by proctologists and gastroenterologists, is rapidly becoming part of the armamentarium of the surgeon and indeed of the general practitioner. However, in the past sigmoidoscopy has presented mechanical difficulties. A serious one has been the unsatisfactory character of available proctosigmoidoscopes. This latter difficulty has been eliminated by a newly developed sigmoidoscope which will be described in a separate report.

Another chief difficulty has been the awkwardness of examining a patient on a flat table in either the knee-chest or the lateral Sims position. The patient being so examined is usually most uncomfortable during the procedure and frequently not too cooperative in maintaining the proper position. On the other hand, the mechanical proctosigmoidoscopic tables are too expensive for use except by the specialist. These latter difficulties have been obviated by the development of the proctosigmoidoscopic cradle illustrated in Figure 1.

The patient getting in position for a rectal examination kneels on an upholstered pad. His body is lowered downward against the shoulder pads, supported by a chest band and headrest. If a person is unable to lower himself, the

FIG. 2. Combination examining table.

cradle-swing can be brought up to the vertical position in which the patient is kneeling; and it is easy for him to lean against the chest band and headrest while the doctor or nurse lowers the cradle to the proper position. This position has been shown by extensive experience to furnish important advantages both for the patient and the doctor. The most important advantage to the patient is the ease by which the correct anatomic position is assumed, together with comfort and feeling of security. The body weight is supported firmly by the chest band and shoulder pads and the arms stretched backward with the hands firmly grasping the handlebars. This position makes it impossible for the patient to move away when instrumentation is started, a procedure usually tried by the patient with other tables. Thus the position greatly simplifies introduction of the instrument by the doctor. Furthermore, in this position the abdomen is not supported and this prevents the patient from cramping himself or exerting pressure on the abdomen; this in turn prevents compression of the lower bowel and makes diagnostic observation and treatment much more easily accomplished.

For the purpose of economy in office space and cost of equipment it was decided to incorporate the cradle in a combination examining table. After much experimentation the table illustrated in Figure 2 was developed.

The examining table is compact and small, 68 inches long, 34 inches high and 24 inches wide, and is of sufficiently light weight to be easily moved. The frame is chrome-plated steel tubing which affords unusually sturdy construction. Angulated legs prevent sliding and give stand. The upholstery is of rubber, hair and plastic covering and is exceptionally comfortable, durable, sanitary and is washable. The top of the table consists of two sections. The smaller head-end section can be raised or lowered through an arc of 95 degrees by means of a simple mechanism. The undersurface of the larger section carries a stainless steel pan. The portion of the table situated above this pan represents a readily removed insert, the removal of which places the pan into position for douching. To this larger section are attached stirrups for gynecologic and genitourinary examinations, while beneath it is the sigmoidoscopic cradle.

There is a step at the foot of the table which makes it easy for the patient to mount it. This step is attached to accessory legs which, when the foot of the table is raised, swing downward and support this end at such increased elevation that the patient is placed in the Trendelenburg position. Then by folding the larger hinged section over the small head section of the table top, the sigmoidoscopic cradle is in the proper position for use as illustrated in Figure 1.

Acknowledgment: The development of these apparatus represents the cooperative efforts of the staffs of the Gastrointestinal and various other Departments of the Boston City Hospital and the Brusch Medical Centre; together with the services of the Rabin Electrical Contracting Company, Esselin Laboratories and the Eder Instrument Company,* Chicago, Ill.

* These apparatus are manufactured by the Eder Instrument Company of Chicago.

AN INTRALUMINAL VEIN STRIPPER*

GEORGE E. WANTZ, JR., M.D.
Phoenixville, Pennsylvania

STRIPPING or excision is an accepted treatment of varicose veins. The renewed interest in the procedure has reflected the superior results obtained as compared to high-low ligation, with or without adjunctive sclerosing agents. The common intraluminal stripping instrument used is a semi-flexible rod 24 inches in length fitted at both ends with an olive tip. The distal tip is small while the proximal tip may vary widely in size. This is threaded through the lumen of the vein to be stripped and withdrawn. In this action the vein should accordion pleat against the proximal tip. Tributaries are ligated if encountered or controlled by compression.

Intraluminal instruments in previous use have not insured successful stripping. The saphenous vein, in spite of a large proximal tip, may completely invaginate instead of pleating against the proximal tip. If unrecognized, the saphenous vein may break leaving behind a segment which is difficult to secure. Again, although the saphenous vein remains pleated on the stripper, its tributaries if uninterrupted may break at unpredictable sites. It is of little consequence if this occurs far from the saphenous vein in the subcutaneous tissue. If, however, it is a communicating vein, a rent may be made in the femoral vein. More often the reverse occurs and the tributary is torn so as

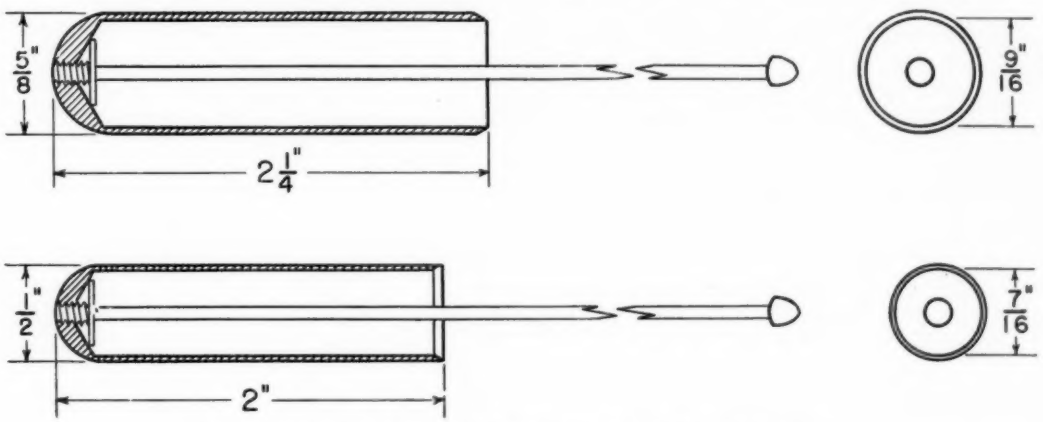


FIG. 1. Measured drawing of the intraluminal vein stripper.

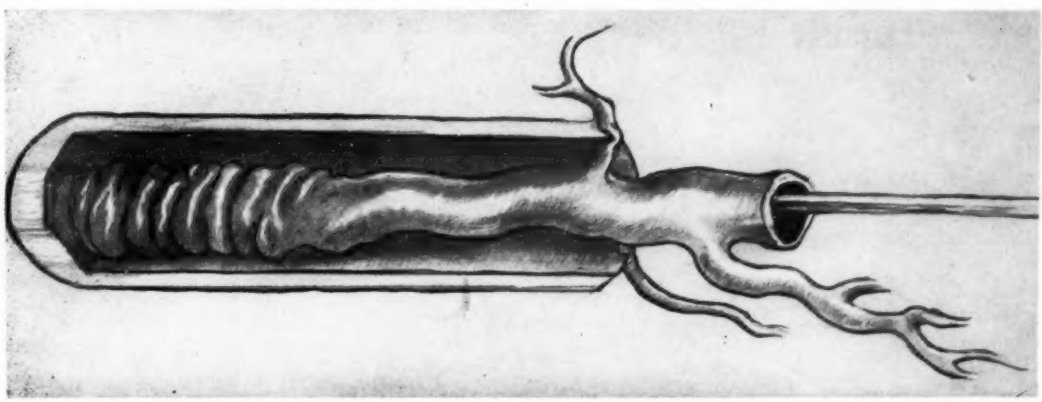


FIG. 2. Action of the vein stripper in use.

* From the Department of Surgery of The New York Hospital-Cornell Medical Center, New York, N. Y.

to include a large segment of the wall of the saphenous vein.

To overcome these shortcomings the common intraluminal stripper was modified by changing the proximal tip to a long and hollow receptacle with sharp but not keen presenting edges. The vein then accordion pleats on the stripper within this cup and cannot invaginate. The sharp edge of the cup provides a dividing point of the tributaries reasonably close to the saphenous vein, thereby avoiding rents in the saphenous vein or the more serious possibility of a rent in the femoral vein.

The cups are of two sizes and interchangeable depending upon the sizes of the incompetent vein. (Figs. 1 and 2.) The large cup which will hold the entire greater saphenous vein is $\frac{5}{8}$ inch in diameter, $2\frac{1}{4}$ inches in length and has an inside diameter of $\frac{9}{16}$ inch. Its edge is sharpened from the outside. The smaller cup, used in stripping the small veins from the leg, is $\frac{1}{2}$ inch in diameter, 2 inches in length and has an inside diameter of $\frac{7}{16}$ inch. It is sharpened from the inside. A diameter of $\frac{1}{2}$ inch is necessary to allow ample room for the vein to enter. Thus by sharpening the smaller cup from the inside the effect is gained. By sharpening the larger cup from the outside the effect is to lessen the external diameter while maintaining a large lumen. During stripping only the branches of the vein being excised are interrupted as they are under tension. A core of subcutaneous tissue is not excised nor is the skin injured.

In use this instrument has given gratifying results in over 150 cases. The cup can be changed if desired during the procedure without removing the stripper from the vein. In practice, however, we have merely chosen the appropriate cup and excised the vein in one segment as far as the stripper could be threaded, even if this was the entire length of the greater saphenous vein. No attempt is made to ligate the tributaries as hemorrhage is easily controlled by compression. There have been no complications and the patients have had no unusual discomfort postoperatively. The saphenous nerve was never injured. The instrument has been used on incompetent greater saphenous venous systems but is not recommended for the lesser saphenous vein as a portion of its course is beneath the deep fascia of the leg.

AN IMPROVED PNEUMATIC ARM TOURNIQUET

HERBERT E. HIPPS, M.D.
Waco, Texas

STANDARD pneumatic tourniquets in common use today wrap around the middle of the arm, hence it is possible to operate only on the lower one-third of the shaft of the humerus.

This new tourniquet wraps around the shoulder (Fig. 1) thus making it possible to operate on the shaft of the humerus almost as high as the surgical neck. The special features of this tourniquet are a harness that holds the tourniquet on the top of the shoulder and a large sponge rubber pad which threads over the tourniquet band and fits high up in the axilla. It can be used, if desired, just like any other pneumatic tourniquet, by detaching the axilla pad and wrapping the tourniquet around the arm or leg in the usual way. It can be applied easily and quickly by any nurse. The pressure can be released and reapplied during the operation without the tourniquet becoming displaced.

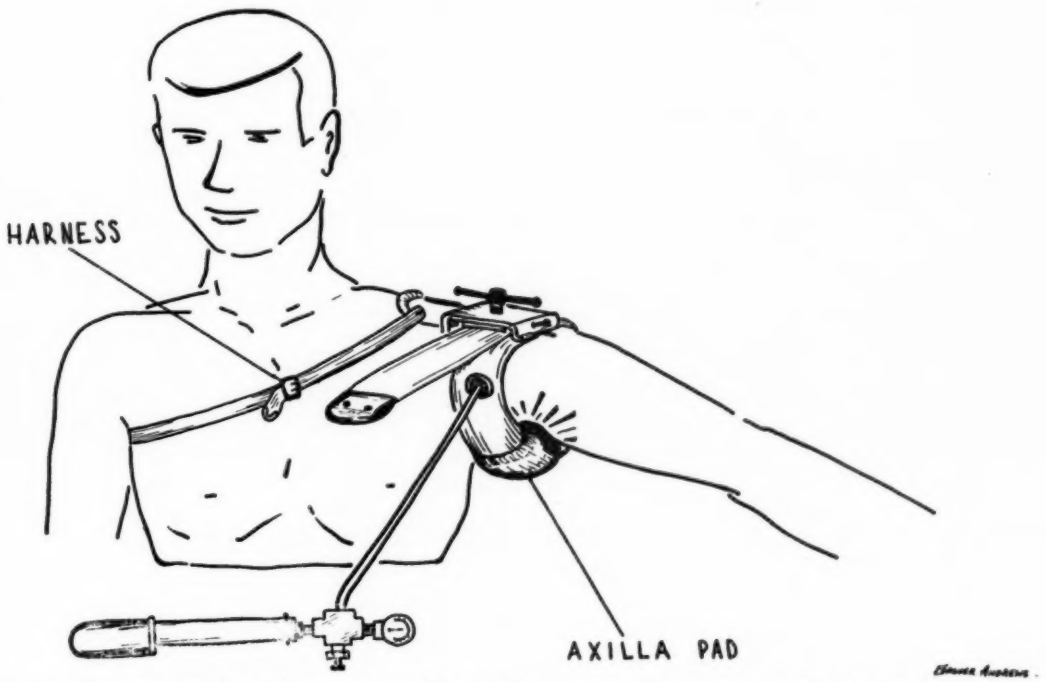


FIG. 1. Shows tourniquet in proper position, with axillary pad in place and with harness holding tourniquet on top of shoulder.

It has been used in the shoulder position on fifteen or twenty different cases with satisfactory, harmless hemostasis being secured in every instance.

MODIFICATIONS OF THE METZENBAUM AND MASSON NEEDLE HOLDERS

PAUL R. FARRINGTON, M.D.
Boulder, Colorado

IN using the Metzenbaum and the Masson needle holders difficulty is experienced in suturing in deep situations such as the tonsillar fossa, vaginal vault, pouch of Douglas or region of the common duct because the hand of the operator gets in the line of vision.

An instrument manufacturer* was asked to bend the Metzenbaum needle holder 30 degrees on the flat 2½ inches from the proximal end. This gives excellent visibility; and as long as the angle is 30 degrees or less, there is no interference with operation of the ratchet. (Fig. 1.)

Because of the success with this modification the jaws of the 10 inch Masson needle holder were slotted to provide for holding small and medium-sized needles in such a direction as to permit placing sutures in planes facing the operator. The handles were also bent 30 degrees on the flat to drop the hand of the operator out of the line of sight. This needle holder is especially useful in suturing the bladder peritoneum to the posterior peritoneal surface of the vaginal stump in complete hysterectomy.

The needle holders combine desirable features present in other patterns and have proved very useful.

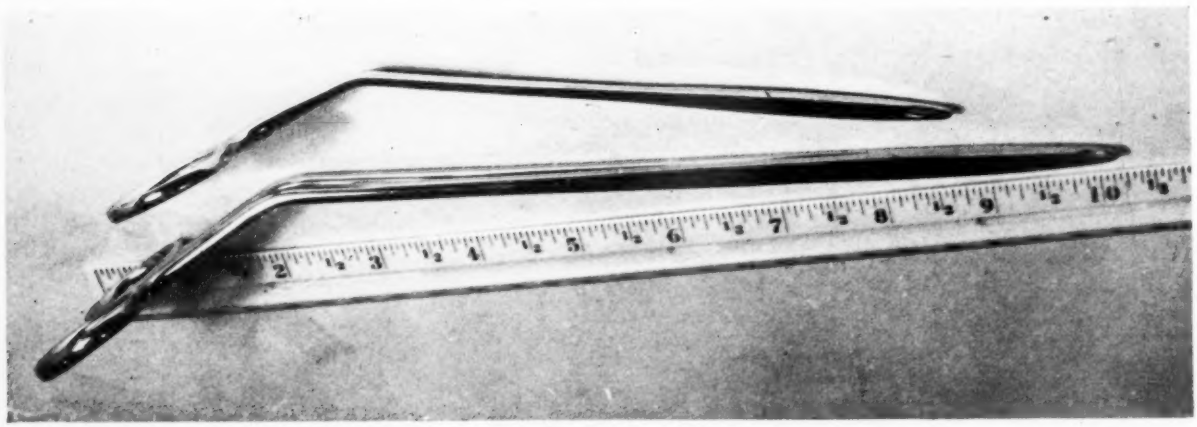


FIG. 1.

* V. Mueller & Co., Chicago, Ill.

AUTHOR INDEX TO VOLUME LXXXVI

Abbott, C. C., 753
Abramson, P. D., 244, 348
Alexander, C. A., 210
Allen, A. W., 545
Allen, R. F., 628
Amspacher, W. H., 713
Andorko, J. E., 368
Ansbro, F. P., 368
Artz, C. P., 713

Bacon, H. E., 572
Barney, C. O., 237
Barron, J., 255
Behan, R. J., 81
Beller, M. L., 123
Berkowitz, J., 549
Berman, E. J., 436
Berman, J. K., 436
Blair, J. D., 139
Blundell, A., 368
Bodell, B., 368
Bodkin, L. G., 395
Botsford, T. W., 605
Brav, E. A., 139
Bromberg, F., 29
Brunschwig, A., 1
Bundens, W. D., 273
Burdette, W. J., 464
Burnett, J. J., 684
Byrne, J. J., 181

Camp, O. B., 240
Case, T. C., 282
Cattell, R. B., 613
Caulfield, P. A., 249
Caylor, H. D., 23
Charet, R., 175
Chittenden, R. F., 128
Chodoff, R. J., 484
Christopherson, W. M., 224
Cianos, J. N., 357
Cloward, R. B., 145
Cole, F., 50
Conrad, H. A., 264
Conston, A. S., 484
Conway, E. W., 751

Danaher, H. H., 359
Davies, O. G., 480
Davis, J. H., Jr., 713
DeCourcy, J. L., 37
Del Beccaro, E., 75
Desforges, G., 116
Dion, H., 246
D'Onofrio, G. R., 169
Dunphy, J. E., 605

Eisaman, J. L., 23
Eisenstodt, L. W., 53

Fair, G. L., 472
Fallis, L. S., 255
Farrington, P. R., 760
Ferguson, J. A., 494
Fettes, D. S., 169
Figares, E., 632
Fleming, J. M., 188
Floyd, V. T., 112
Frachtman, K. G., 161
Friedgood, C. E., 363
Friedmann, F., 318
Fry, W., 736

Gabriel, W. B., 583
Gale, K. E., 237
Giles, R. C., 75
Gioia, J. D., 222
Glass, B. A., 348
Goldenberg, I. S., 292
Gordon, C. A., 336
Grady, E. D., 387
Grantham, E. G., 61
Gratiot, J. H., 747
Grimes, O. F., 480
Gross, S. W., 58

Harris, A., 739
Harris, J. W., 577
Haskin, J. W., 98
Hawkins, W. J., 678
Higgins, J. R., 224
Hipps, H. E., 759
Hirsch, S., 643
Hoerner, M. T., 646
Hogan, H. J., 468
Holloway, J. B., 387
Hoyt, H. S., 206
Hunt, C. J., 125, 361

Iverson, R. K., 665
Izzo, P. A., 260

Jackman, R. J., 678
Jackson, C. E., 23
Jefferson, N. C., 309
Jones, C. M., 608

Kahn, J. W., 175
Kaplan, I. W., 192
Karlin, S., 192
Kitchen, W. M., 511
Klein, R. R., 515
Klingensmith, W., 75
Knott, J. I., 196
Kohn, A., 29
Krantz, S., 387
Kratzer, C. L., 523
Krueger, F. M., 154
Kuperstein, D., 743

LaCorte, S., 120
Lahey, F. H., 480
Lamont, E. S., 200
Lamphier, T. A., 414, 755
Laplume, A. A., 401
Lazarus, J. A., 318
Lisa, J. R., 222
Livingston, S. F., 175
Long, N. G., 414
Lowell, E. J., Jr., 572
Lucas, M. A., 539
Lund, P. C., 312

Mackles, A., 743
Madigan, H. S., 249
Marazita, A. J. D., 214
Markee, R. K., 562
Marshall, V. F., 45
Martin, D. R., 244
Martin, W. L., 707
Martone, H. L., 169
Mazzola, N. J., 169
Mazzola, V. P., 169
McAdams, A. J., 530
McArt, B. A., 551
McCarty, R. T., 500
McCaughan, J. M., 102
McClure, C. W., 755
McCullough, J. Y., 224
McGaughey, H. S., 486
McKittrick, L. S., 625
McLeod, C. E., 739
Mersheimer, W. L., 688
Metzger, W. I., 325
Michele, A. A., 154
Miley, G. P., 401
Miller, E. M., 688
Mitchell, F. V., 169
Mizer, F. R., 98
Moon, L. E., 505
Morris, W. R., 216

Necheles, H., 309
Nicola, T., 85

Ninecurt, J., 102
Noyes, M. B., 665

Okulicz, S. J., 45
O'Leary, J. L., 336
Oppenheimer, M. J., 591
Owens, G., 410

Palumbo, L. T., 70
Park, B. J., 273
Pate, J. W., 3, 152, 653
Pearce, A. E., 751
Pearson, L. R., 551
Persky, L., 720
Pollard, C., Jr., 61
Popper, H. L., 309
Poskanzer, C. L., 696
Presman, D., 718
Propst, H. D., 301

Recio, P. M., 591
Reiss, E., 713
Ripstein, C. B., 363, 422
River, L., 208
Roback, R. A., 468
Roe, H., 23
Ronchese, F., 376
Rook, F. W., 404
Rosenbaum, M. M., 636
Rosenthal, A. H., 336
Ruby, R. H., 102
Ryan, J. E., 535

Sala, A. M., 353
Savlov, E., 605
Sawyer, P. N., 3, 152, 653
Saxe, D. H., 553
Scarborough, R. A., 515
Schafer, C. S., 157
Schatten, W. E., 720
Schenck, S. B., 743
Schmidt, R. M., 696
Schoonover, R., 417
Schottenfeld, L. E., 659
Schweizer, H. W., 14
Scott, O. B., 227
Seligmann, W., 466
Shaw, E. S., 107
Sherber, D. A., 331
Silverstein, J., 208
Silverstein, M. E., 688
Smith, C., 206
Smith, R. T., 732
Sneierson, H., 429
Stein, H. D., 229
Stein, I., 123
Stein, R. O., 123
Steinberg, N., 556
Steppacher, L. G., Jr., 229
Sterling, J. A., 246
Stevens, R. C., 260, 684
Stockman, J. M., 560
Sullivan, R. E., 684
Summers, J. E., 433
Sutton, A. P., 476
Sweeney, J., Jr., 368
Swenson, O., 497
Swinton, N. W., 562

Tamerin, J. A., 325
Thompson, L. R., 92
Tomsykoski, A. J., 260, 684
Tope, J. W., 208
Trace, H., 75
Trimpi, H. D., 572
Trinidad, S., 476
Tropea, F., Jr., 707
Turnbull, R. B., Jr., 617

Venturo, R. C., 641
Virshup, M., 422

Wallace, F. T., 233
Wantz, G. E., Jr., 757
Ware, G. W., 264
Wax, W. V., 728
Weiner, J. J., 120, 353
Wells, P., 486
West, J. P., 112
Wexler, D. J., 29
Whiting, J. A., 233
Wiggins, H. E., 273
Wilson, H., 116
Wilson, R. S., 233
Wiltberger, B. R., 723
Wittmer, S. C., 70
Wolfe, N. A., 224
Wollgast, G. F., 98
Wood, P. M., 14
Wright, L. T., 325

Young, V. T., 560

Zaydon, T., 707, 751

SUBJECT INDEX TO VOLUME LXXXVI

(E.) = Editorial

Abdomen, foreign body in, 472
Abortion, tubal, and regression of carcinoma, 743
Abscesses, perianal and developmental cysts, 678
Accidents of labor, 336
Acid-base equilibrium and motility of colon, 591
Adeno-acanthoma of rectum, 556
Adenocarcinoma
  colloid, of bladder, 739
  in horseshoe kidney, 417
Adrenalectomy, bilateral one-stage, 208
Alimentary tract, thoracic duplication of, 264
Amputation, scapulohumeral, 728
Anastomosis for atresia of small bowel, 229
Anesthesia
  and cardiac arrhythmias, 23
  and succylincholine chloride, 312
  caudal, for anorectal surgery, 636
  for thyroid surgery, 368
Anesthetic safeguards, 14
Aneurysm of plantar artery, 244
Anorectum, surgery for, 636
Antibiotics in arteriovenous fistula and septicemia, 175
Anus
  Paget's disease of, 551
  vaccination around, 549
Appendix, vermiform, carcinoma of, 188
Arm tourniquet, pneumatic, 759
Arrhythmias, cardiac, during anesthesia, 23
Arteriography of hip joint in femoral fractures, 404
Artery
  epigastric, rupture of, 157
  hepatic, interruption of, 309
  plantar, aneurysm of, 244
Aspirator, cystoscopic clot, 206
Atresia
  congenital, of small bowel, 229
  of esophagus with tracheo-esophageal fistula, 436
Aureomycin dressing in surface wounds, 325
Auricle, herniation of, 736

Bactericidal agents, effect of, on sterility of surgical linen, 301
Balloon receptacle for drainage of common bile duct, 753
Bile duct
  common, drainage of, 753
  left intrahepatic, stricture of, 120
Biliary fistulas, 181
Biliary tract, carcinoma of, 292
Billroth I, use of, 227
Bladder, adenocarcinoma of, 739
Bleeding, control of, 331
Blood
  irradiation therapy in deltoid bursitis, 401
  loss during surgery, 50
Bone defects of forearm, 139
Bowel
  bleeding, roentgenologic examination of, 511
  small, atresia of, 229
Breast
  fibrosarcoma of, with metastases, 353
  form for mastectomy patients, 466
  radical surgery of, 282
Burn patient, care of, 713
Bursitis, deltoid, and Knott technic, 401
Buttock, hidradenitis suppurativa of, 632

Cancer
  of cervix (E.), 1
  of colon and rectum, 489
    review of, 523
  of mouth and tongue, 387
  of thyroid, 732
Carcinoid
  multiple, of rectum, 553
  tumors of stomach, 224
Carcinoma
  and anorectal fistula, 560
  high esophageal, 665
  of biliary tract, 292
  of cervix, regression of, 743
  of stomach, 216
  primary, of vermiform appendix, 188
  rectal, and control of pain, 395
Cardiac arrest, emergency infracostal approach for, 29
Cast, turnbuckle, for separation of symphysis pubis, 468
Cecum
  volvulus of, 116
    due to lithopedion, 348
Cervix
  cancer of (E.), 1
  carcinoma of, 743
Cholecystectomy for biliary dyskinesia, 429
Cleft lip, surgery for, 200
Colon
  cancer of, 489, 523
  distal, perforations of, 515
  diverticulitis of, 545
  motility of, and altered acid-base equilibrium, 591
  polyps of, 577
  surgery of, 572
    mortality in, 530
  wound healing in surgery of, 494
Complications after open reduction of fractures, 273
Constipation in children, 497

Cranium bifidum and spina bifida, 410
Cystadenoma of ovary with pleural effusion, 107
Cysts
  developmental, 678
  pancreatic, 255

Disc
  ruptured intervertebral, 145
  syndrome and fibrositis, 414
  therapy, lumbar, 723
Disease, Mondor's, 357
Dislocation, recurrent, of shoulder, 85
Diverticula of duodenum, 233
Diverticulitis of colon, 545
Dowel, prefit, intervertebral body fusion, 723
Drainage
  of common bile duct, 753
  thoracic, with glass button, 210
Duodenum, diverticula of, 233
Dyskinesia, biliary, 429

Editorials
  Surgical treatment of cancer of the cervix, 1
  Intrathoracic projections of thyroid origin, 125
  Fundamentals of wound healing, 249
  Dr. Frank Lahey, 361
  Surgery in the aged, 643
Elbow, tennis, hydrocortisone in, 123
Embolectomy, cystoscopic clot aspirator in, 206
Endometriosis, 359
Enteritis, regional, 70
Esophagogastrostomy for esophageal carcinoma, 665
Esophagus
  congenital atresia of, 436
  freeze-dried grafts of, 152
Excision for arteriovenous fistula and septicemia, 175

Femur, fracture of, 404
Fibrosarcoma of breast with metastases to lymph nodes, 353
Fibrositis and disc syndrome, 414
Fistula
  anorectal, and carcinoma, 560
  arteriovenous, after hysterectomy, 240
    and septicemia, 175
  biliary, 181
  perianal, and developmental cysts, 678
  tracheo-esophageal, and atresia of esophagus, 436
Fistula-in-ano in infants, 641
Forearm bone defects and reconstruction, 139
Foreign body
  in hernia sac, 751
  in intestine, 237
Fractures
  of femur, arteriography in, 404
  of tibia, 273
Freeze-dried grafts, aortic, 3
    characteristics of, 653
  esophageal, 152
Furacin soluble powder for wound infections, 363
Furadantin for genitourinary tract infections, 720
Fusion, spinal, and ruptured disc, 145

Gastrectomy, total, 646
Genitourinary tract infections, 720
Glomus tumor, 192
Grafts
  aortic, fresh and freeze-dried, 653
    freeze-dried, 3
  esophageal, freeze-dried, 152

Hematemesis in mesenteric thrombosis, 246
Hemorrhage
  massive gastric, 222
  subphrenic, in hepatoma, 318
Hepatoma complicated by subphrenic hemorrhage, 318
Hernia
  mesentericoparietal, 75
  sac, free fish bone in, 751
Herniation of left auricle, 736
Hidradenitis suppurativa of buttock, 632
Hip joint, arteriography of, 404
Hydrocortisone in tennis elbow, 123
Hypertension and nephrectomy, 45
Hysterectomy and arteriovenous fistula, 240

Ileum
  duplication of, 684
  lymphoblastoma of, 98
Incontinence, anal, Thiersch's operation for, 583
Infections, wound, treatment of, 363
Intestinal flora and terramycin, 628
Intestine
  examination of cells and parasites from, 92
  obstruction of, 237
Intrathoracic projections of thyroid origin (E.), 125
Involution, spontaneous, of cutaneous vascular tumors, 376

Kidney, horseshoe, adenocarcinoma in, 417
Knee, ligaments of, tension tenodesis for, 154
Knott technic in deltoid bursitis, 401
Kyphoscoliosis and pregnancy, 486

Labor, accidents of, 336
Lahey, Frank (E.), 361
Leiomyosarcoma of stomach, 696
Ligaments of knee, and tenodesis, 154
Ligation, partial, of portal vein, 309
Ligatures and wire sutures, 196

Limb prosthesis, 128
Linen, surgical, effects of bactericidal agents on sterility of, 301
Lip, cleft, surgery for, 200
Lithopedion and volvulus of cecum, 348
Liver necrosis and interruption of hepatic artery, 309
Lymphoblastoma, follicular, of ileum, 98

Masson needle holder, 760
Mastectomy patients, breast form for, 466
Megacolon, congenital, 102
Metastases in fibrosarcoma of breast, 353
Metzenbaum needle holder, 760
Mondor's disease, 357
Morbidity in colonic surgery, 530
Mortality in colonic surgery, 530
Mouth, cancer of, 387
Muscle
  rectus abdominis, rupture of, 157
  relaxant, succinylcholine chloride as, 312

Nasal deformity and cleft lip surgery, 200
Necrosis, liver, 309
Nephrectomy and hypertension, 45
Nerves, peripheral, incisions for exposures of, 61
Neurofibrosarcoma, presacral, 484
Neurosurgery for intractable pain, 58

Obstetric Clinic
  Accidents of labor, 336
Obstruction
  and abdominal foreign body, 472
  intestinal and foreign bodies, 237
Omentum, primary torsion of, 707
Omphalocele and omphalomesenteric duct, 747
Omphalomesenteric duct, persistent, with omphalocele, 747
Ovary, ruptured multilocular pseudomucinous cystadenoma of, 107

Paget's disease of anus, 551
Pain
  from rectal carcinoma, control of without sedation, 395
  intractable, neurosurgery for, 58
Pancreas
  annular, 260
  cysts of, 255
Perforations
  acute gastroduodenal, 688
  traumatic, of rectum and distal colon, 515
Pheochromocytoma, 37
Phlebitis
  cord-like, of wall of thorax, 353
  pseudoembolic, 480
Phlegmasia cerulea dolens, 480
Pilonidal sinus disease, 562
Plastic surgery for cleft lip, 200
Plating of fractures, tibial, 273
Polyposis coli, familial disseminated, 500
Polyps of rectum and colon in children, 577
Pregnancy
  and kyphoscoliosis, 486
  unruptured tubal term, 161
Procidentia of rectum, 605
Proctology, transition period in, 505
Proctosigmoidoscopic cradle and examining table, 755
Prolapse
  of rectum, Thiersch's operation for, 583
  uterine, 169
Prostatitis following ureterolithotomy, 718
Prosthesis limb for children, 128

Reconstruction of forearm bone defects, 139
Rectum
  adeno-acanthoma of, 556
  cancer of, 489, 523
  carcinoid of, 553
  polyps of, 577
  procidentia of, 605
  surgery of, 572
  traumatic perforations of, 515
  villous tumors of, 535, 539
Reduction, open, complications following, 273
Rhinitis, vasomotor, 53
Rhinoplasty for vasomotor rhinitis, 53
Roentgenology in bleeding bowel, 511
Rupture
  of lumbar intervertebral disc, 145
  of rectus abdominis muscle and epigastric arteries, 157

Sarcoma involving spleen, 422
Scars, painful, 81
Septicemia, cure of, 175
Shoulder, recurrent dislocation of, 85
Sinuses, perianal, and developmental cysts, 678
Sphincter mechanisms, 659
Sphincterotomy for biliary dyskinesia, 429
Sigmoid colon, villous tumors of, 539
Spina bifida and cranium bifidum, 410
Spleen, involvement of, by sarcoma, 422
Stomach
  carcinoid tumors of, 224
  carcinoma of, 216
  leiomyosarcoma of, 696
  volvulus of, 112
Stricture
  benign non-traumatic, of left hepatic duct, 120
  urethral, 214
Subphrenic hemorrhage and hepatoma, 318
Succinylcholine chloride, clinical evaluation of, 312

Surgery
anorectal, caudal anesthesia for, 636
blood loss during, 50
for cancer of cervix (E.), 1
for exposure of peripheral nerves, 61
for procidentia of rectum, 605
for regional enteritis, 70
in the aged (E.), 643
of colon, mortality in, 530
and rectum, ureteral studies in, 572
wound healing in, 494
of diverticulitis of colon, 545
of thyroid gland, 368
plastic, for cleft lip and nasal deformity, 200
radical breast, 282
Sutures, wire, and ligatures, 196
Symphysis pubis, wide separation of, 468
Symposium on Ulcerative Colitis
Colitis, chronic ulcerative, medical aspects of, 608
Colitis, chronic ulcerative, surgical aspects of, 613
Ileostomy, management of, 617
Colitis, ulcerative, discussion of symposium on, 625

Tenodesis, tension, 154
Terramycin, effect of on intestinal flora, 628
Testis, tumors of, 476
Thiersch's operation for anal incontinence, 583
Thoracic
drainage tubes, pleural tunnel for, 464
duplication of alimentary tract, 264
Thorax
continuous drainage of, 210
phlebitis of anterolateral wall of, 353
Thrombectomy, cystoscopic clot aspirator in, 206
Thrombosis, mesenteric, and hematemesis, 246
Thyroid
cancer of, 732
gland, anesthesia for surgery of, 368
origin, intrathoracic projections of (E.), 125
Tibia, fractures of, 273
Tongue, cancer of, 387
Torsion of omentum, 707
Tourniquet, pneumatic, 759
Trauma, scapulohumeral amputation caused by, 728
Tubes, thoracic drainage, pleural tunnel for, 464
Tumors
carcinoid, of stomach, 224
cutaneous vascular, 376
glomus, 192
of tunica vaginalis testis, 476
villous, of rectum and sigmoid colon above peritoneal reflection, 539
of rectum below peritoneal reflection, 535
Turnbuckle for wide separation of symphysis pubis, 468

Ulcers and varicose veins, 443
Ureteral studies in colonic and rectal surgery, 572
Ureterolithotomy and prostatitis, 718
Urethra, stricture of, device for, 214
Uterus, prolapse of, 169

Vaccination, accidental, about anus, 549
Vagina, examination of cells and parasites from, 92
Varicose veins and ulcers, 443
Vein
portal, ligation of, 309
stripper, intraluminal, 757
Volvulus
of cecum, 116, 348
of stomach, 112

Wound
healing, fundamentals of (E.), 249
primary, abdominal, in colonic surgery, 494
infections, treatment of, 363
surface, aureomycin dressing in, 325